UNIVERSITY of RWANDA

COLLEGE OF MEDICINE & HEALTH SCIENCES
SCHOOL OF MEDICINE & PHARMACY
DEPARTMENT OF SURGERY

FACTORS ASSOCIATED WITH TREATMENT DELAYS IN ORTHOPEDIC TRAUMA PATIENTS ATTENDING THE ACCIDENT AND EMERGENCY DEPARTMENT OF THE UNIVERSITY TEACHING HOSPITAL OF KIGALI.

A dissertation submitted in partial fulfillment of the requirements for the degree of Master of Medicine in Orthopedic Surgery, College of Medicine and Health Sciences.

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DECLARATION

I hereby declare that this dissertation **'Factors associated with treatment delays in orthopedic trauma patients attending the Accident and Emergency Department of the University Teaching Hospital of Kigali'** contains my own work except where specifically acknowledged, and it has been passed through anti-plagiarism system and found to be compliant and this is the approved final version of thesis.

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Dedication

To my lovely wife Florence CYUSA TURATSINZE

My son, Enzo Reagan TURATSINZE

My mother, sister, and brother

My aunts and cousins

My colleagues in the residency

My instructors and mentors throughout this learning journey.

Acknowledgement

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Emile TURATSINZE, MD

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List of abbreviations

A&E: Accident and Emergency

CHUK: University Teaching Hospital of Kigali

ICU: Intensive Care Unit

IRB: Institution Review Board

RTA: Road Traffic Accident

RTCs: Road traffic crashes

RTIs: Road Traffic Injuries

SAMU: Service D'Aide Medicale Urgente

vs.: Versus

WHO: World Health Organization

Key words:

Orthopedic trauma, injuries, Fractures, surgical delays

ABSTRACT

Background: The delays to surgery are a global health problem, especially in trauma patients, given injuries are currently a major cause of deaths worldwide. However, the status of emergency orthopedic surgical delays in the Rwandan hospitals is not known. This study aims at describing the factors associated surgical treatment delays in emergency trauma patients received at the emergency of CHUK, the largest referral hospital in Rwanda.

Methods: This was a single center cross-sectional study, conducted at the CHUK accident and emergency department, in the orthopedic unit. A sample of 112 patients was recruited. We recorded demographic data and injury characteristics. We evaluated the timing status between the injury and surgery, and we analyzed the factors associated with delayed surgery using a logistic regression model made of a full model containing all covariates and a final, reduced model containing only significant independent variables determined using a backward model selection approach. The goodness of fit was assessed using the Hosmer Lemeshow test. The model validation was done using training dataset (70%) and test dataset (30%) through the comparison of conclusions from them.

Results: A total number of 112 patients constitutes our study sample size, 60 % of them were from the capital city, Kigali.72.32% were males while 27.68% were females. 26.79% of selected patients had no insurance. 57% of our patients had open fractures, with the median time from injury to surgery being 2 days; while 48.65 % had closed fractures with the median time from injury to surgery was 4 days. In general, 64.22% of cases were delayed to have surgery. The majority of delayed patients had open fractures (37 patients) while 32 patients had closed fractures. Delays were commonly associated with lack of theater slot, lack of health insurance and other challenges like lack of implants, lack of sterile equipment and lack of experienced surgeon.

Conclusion: surgery delay was related to both patient and institutional factors. These included patients lacking a health insurance, lack of theater slots, lack of implants, insufficient staff as well as lack of orthopedic emergency patient flow system. Improved community health insurance sensitization, increasing the infrastructure and personnel, and better usage of available resources would help in decreasing the amount of delays.

CHAPTER I. INTRODUCTION

The current era on global health landscape is notable for a major shift in causes of death from infectious diseases towards injuries with Road Traffic Injuries (RTIs) ranking at the top [1], and more prevalently musculoskeletal injuries[2]. The World Health Organization (WHO) report injuries to rank as number one killer amongst young adults[3]. Injuries, notably road traffic related are on their rise in low-income countries and the trend is likely to increase, yet there is a high inaccessibility and delay to optimal health care due to multiple factors such as infrastructures, socio-economic factors and others[4].

The delays to treatment have been largely studied and have been categorized into 3 main classes including the delay in seeking care, delay in reaching care, and delay in receiving care. The delay in seeking care is the delay of the patient to decide to seek care. The second delay happens when the patient knows that he/she has a problem and decides to seek care, but due to some problems like inaccessibility or finance issues, he/she delays to reach appropriate care. The third delay happens when the patient has arrived at the health facility but delays to receive appropriate care due to inadequacies within the health facility[5]. The 3 delay model was initially developed to establish delays that contribute to adverse perinatal care in maternity, but it was later extrapolated to other surgical emergencies[5,6].

The delay to surgery is a global problem[7,8]. Lankester et al. audited delays in orthopedics and trauma at the Royal United Hospital, Bath, United Kingdom and found that lack of theater slot was a problem, followed by other problems like waiting for an experienced surgeon to be available [8]. In addition, different authors in the low and middle income countries have pointed out the limited workforce in the services of surgery and anesthesia, inadequate infrastructures and restricted access to surgical services[6]. Ifesanya et al. at the University hospital of Ibadan, Nigeria, when looking at orthopedic treatment delays, they found out that the biggest cause of delays was a lack of theater slots[7]. Other major causes of surgery delay according to Ifesanya et al. were theater inefficiency, patients with insufficient or no funds and, presence of comorbidities in patients mostly who had their

The government of Rwanda has taken important measures to decrease the delay to treatment by establishing the government-funded pre-hospital ambulance system called "Service D'Aide Medicale Urgente" (SAMU). This pre-hospital ambulance system has a trained personnel, ambulances and other equipment necessary to attend to almost all types of emergency conditions in the pre-hospital environment[9]. However, despite these efforts by the Government or Rwanda, the delay to treatment is still a significant problem in the country.

In their study defining the three delays in referral of surgical emergencies from District Hospital to the University teaching hospital of Kigali, Mpirimbanyi C. et al. found that in the transferring process, the delays were caused by lack of financial means (5%) and lack of health insurance (2%). At the referral hospital, the delays were mainly due to investigation delays, including the laboratory and the radiology issues[6]. Currently there is a debate that the delays to treatment in Rwanda may be enhanced by our pyramidal referring system where patients may delay at each level of facility they need to pass through. This applies to all patients except for emergencies and trauma cases which may present initially to the referral hospital[9]. In the orthopedic emergency context, most emergency cases are trauma patients, and they may consult a district or a referral hospital immediately.[6,9,10].

The status of delays in receiving orthopedic surgical care at the referral hospitals in Rwanda is unknown, and this was the focus of our research. In order to decrease emergency orthopedic surgery delays, the institution personnel must be able to understand the factors that are implicated in causing the delays. Studies have been carried out about the surgery delays, in order to determine the main causes of delay[11,12]. A few studies were done in Rwanda in the domain of general surgery[6], but none was done in Rwanda to assess factors associated with orthopedic surgery delays. In this study we aim at describing the factors associated with treatment delays in orthopedic patients received at the emergency of CHUK.

1.1 Problem statement and Study justification

Orthopedic emergency surgery delays affect the patient[13], the system of the health facility and the country in general. Delays in surgical treatment of patients is a major source of poor outcome, frustration, increased morbidity and mortality, especially in cases of hip fracture[7], open fracture, and dislocation[14–17]. The institution is affected in a way that, delayed access to

surgery leads to prolonged in-hospital stay and decreased bed turnover, and thus affecting the whole health system, lagging behind other orthopedic patients supposed to be referred from other referring health facilities[18].

Factors contributing to a delayed surgical procedure can be related to the patient characteristics, to the system, or both. Patient- related factors delaying the surgical treatment include the indication for surgery, patient's comorbidities, and other patient specific issues like lack of funds. System-related factors delaying surgery include delayed access to the operating room, lack of post anesthesia unit bed, unavailability of beds in ward, and lack of supplies like equipment and implants[13].

Understanding the main causes of orthopedic trauma emergency surgery delay is one of the milestones to decrease the amount of time between injuries and surgeries. To the best of our knowledge there is no published paper reporting facts causing delays to access of surgical care in trauma orthopedics in Rwanda, hence we conducted this study aiming to investigate the factors associated orthopedic emergency surgery delays at CHUK, and from there we may be able to contribute in setting guidelines so as to decrease delays in surgical treatment of our patients, thereby improve the system so as to meet our patients' expectations and improve their outcomes.

1.2 Key concepts Definitions

Delayed surgery:

A surgery is delayed when

- A patient with open fractures, dislocations, limb injuries associated with vascular compromise, or compartment syndrome is operated beyond 6 hours.
- A patient with a hip fractures, a closed long bone fractures, or an ankle fractures is operated on beyond 1 day without a medical reason precluding surgery.
- A patient with tendon injuries or simple hand fractures injury is operated on beyond 5 days without a medical reason precluding surgery [7,8].

Ubudehe categories: social –economic categories developed by the Rwandan government as method used to determine the beneficiary of the government social services. They are the principal tools used for determination of the flow of the government resources aimed at social protection to the right beneficiaries[19]. 4 categories exist for the moment:

Category 1: These are very poor and vulnerable Rwandan citizens, who are either homeless or cannot feed themselves without social assistance.

Category 2: These are Rwandan citizens who are able to afford a low class accommodation, whether rent or owned, but who are not gainfully employed, and can only afford to eat once or twice daily.

Category 3: These are Rwandan citizens who are gainfully employed or are the labor employers. Here are found all small farmers who are beyond the subsistence farming and the owners of medium and small enterprises.

Category 4: These are citizens who are chief executive officers of large scale businesses, employee who have full time employment with organizations, industries or companies, owners of lockdown shops or markets and owners of transport businesses [19].

Theater slot: Time slot assigned for each intervention (surgery) in an appropriate theater room during the legal opening hours of the operating theater [20].

1.3 Research question

What are the factors associated with delay in the surgical treatment of orthopedic trauma patients admitted at the emergency of CHUK?

1.4 Objectives

1.4.1 General objectives

To investigate the factors associated with the delay to surgery for orthopedic trauma patients admitted through the emergency department of CHUK.

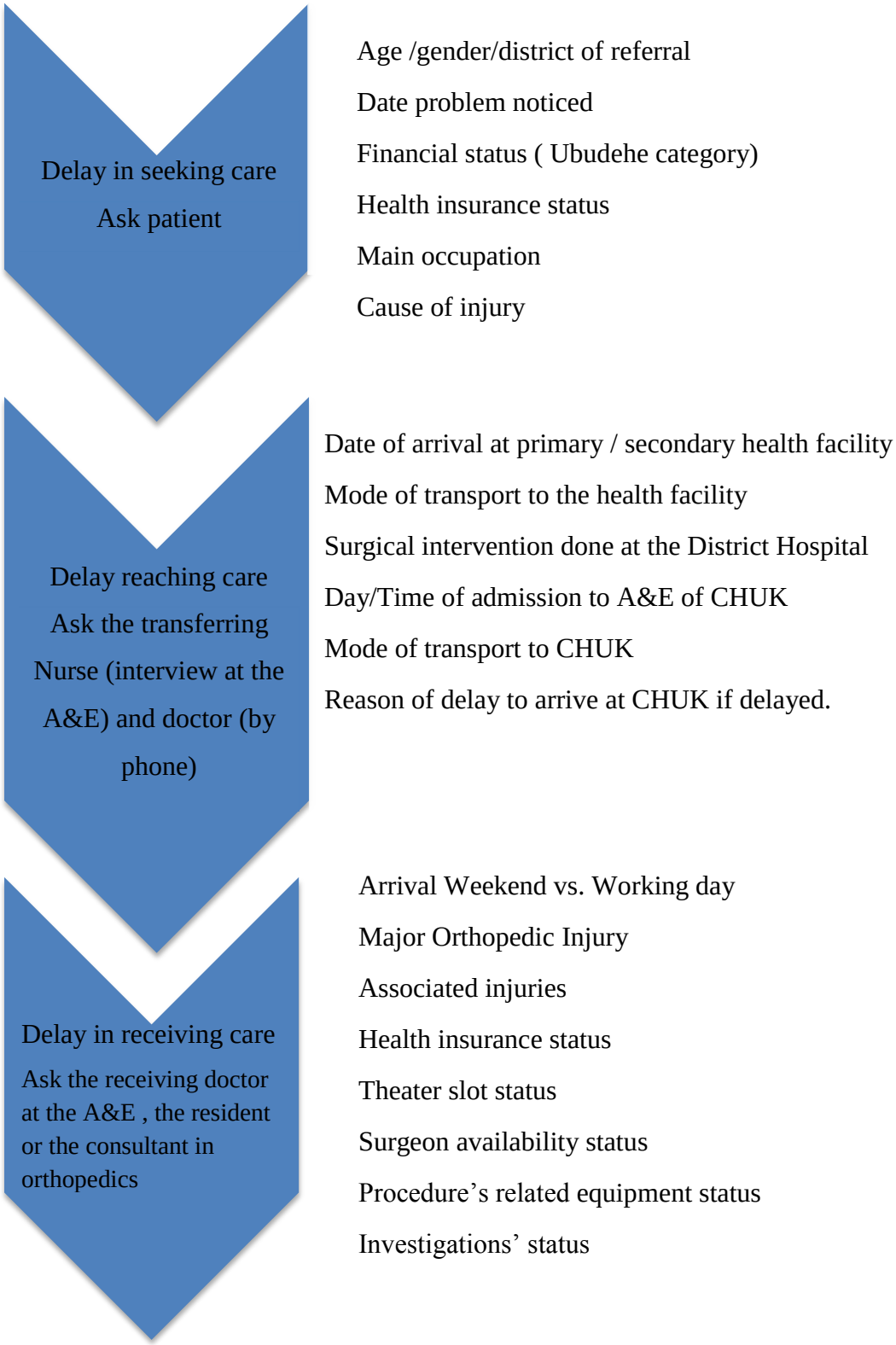
1.4.2 Specific objectives

1. To quantify the treatment delay for orthopedic trauma patients admitted through the emergency department of CHUK.

2. To describe the patient-related factors associated with treatment delays for orthopedic trauma patients admitted through the emergency department of CHUK.

3. To describe systems-related factors associated with treatment delays for orthopedic patients admitted through the emergency department of CHUK.

1.4.3 Conceptual Framework



CHAPTER II. LITERATURE REVIEW

Emergency surgery is an unplanned surgery, whereby patients are scheduled for surgery with minimal preparations[21]. There are conditions in orthopedics, including trauma and some other conditions which have to be operated on in the immediate time, and there are other conditions which can wait for the hospital resources and personnel allow, or the patient's conditions is improved and optimized[21].

2.1 Epidemiology and delays in orthopedic emergencies

Delay in the treatment of surgical patients is an active problem. In a study by Caesar U. et al, it was found that 24% of emergency cases were delayed and rescheduled at least one more time.[21] It has also been noted in an Australian literature that delays occurs in 20 % of all transfers, and it occurs in 9% of orthopedic transfers, giving an idea that transfers are among the issues that may create delays in the treatment of orthopedic cases[22].

Lankester et al. at the Royal United hospital, in their study about delays in orthopedic trauma treatment, it was noted that the number of trauma cases rises each year by approximately 10% [8], and Mohtasham et al[23]. at the orthopedic center of Akhtar, Tehran, in their study on Epidemiology of injuries referred to the Emergency department, they have reported that orthopedic injuries are major causes of referral to health care facilities.

In Rwanda, causes of delays have been defined in general surgery, and they were noted at each step of the referring process. In their research about the delays in referral of surgical emergencies to CHUK, Mpirimbanyi C. et al. [6] found that financial reasons and lack of health insurances delayed patients during the referral process, while they were delayed by problems related to investigations like laboratory and radiology during their stay at the Accident and Emergency of CHUK. Some patients were delayed because of lack of theater slots or the surgeon would not be immediately available. The lack of surgeons and competent anesthesia staff has been found to delay surgeries at the district hospitals.[6] However, the causes of delays have not been defined in orthopedic trauma surgery.

2.2 Orthopedic emergencies and timing of treatment

Acute orthopedic trauma and other emergency orthopedic cases admitted through the emergency, constitute a major spectrum of orthopedic cases, and they often require surgery[8]. Some cases like open fractures, dislocations, contaminated wounds benefit from an urgent treatment in terms of debridement, cleaning, reduction and fixation[8,24]. Some other cases like hip fractures, closed long bone fractures and others can tolerate a certain delay in treatment, though many of these will also clearly benefit from an early surgery. Some other patients including the patient with closed tendon injuries and simple hand fractures may be delayed for a few days without significant harm, though they need to be addressed as well within an optimal timing.

It has been particularly noted that a reduced morbidity and mortality is obtained when early surgery is provided[25,26]. For example, Victor N. et al. in a multicenter study on outcome of delaying hip fractures, they found that patients who were operated in their first 2 days had lower mortality rates compared to those who were operated more than 4 days after they fractured.[25]

It has been remarked also that even if there is no measurable negative effect on the definitive outcome, surgical delays have been associated with significantly increased pains and frustration for patients and caretakers, associated increased hospital length of stay, as well as associated cost of patient care[8]. Delays also lead to cancellation of surgeries and cause inefficiency in the use of hospital resources and loss its revenues[21,27].

Different causes of surgery delay have been studied before. Causes that have been identified by Orosz et al were: the waiting for the usual medical clearance (documentations, investigations) , lack of theater slot, waiting for family discussion and consent, waiting for medical optimization for surgery, admission out of normal working hours and weekends[28,29]. Lack of blood products was the 2nd cause of delayed and postponed surgeries following lack of theater space in a research by Isaac Kajja, while evaluating the causes of delayed surgery at Mulago Hospital in Uganda[30].

Reasons for surgery delays can be medical-related or system related[28,31]. In an article by Charalambous et al., it was found that medical problems and waiting for medical related investigations accounted for most surgical delays, while Youde et al. identified organizational reasons as less important reason for delaying surgeries in hip fracture[32,33]. Other authors have found that two third of the delays were caused by lack of theater space, and some patients by lack of beds[28,34]. In the pediatric orthopedic patients, treatment of time-sensitive cases has been found to be frequently dependent on transfers from referring health facilities[18].

Delay in the treatment of emergent orthopedic surgeries may also depend on the indication of surgery, the comorbidities of the patient and other physiologic disturbances that may be associated with the injury. These may both influence the delays and the poor outcomes[13].

Given the circumstances noted above, appropriate measures at the organizational level of the hospital should be taken to make sure that delays in surgical treatment are minimized as low as possible, not forgetting early surgery should be offered in safe surgical conditions[28].In our settings however, the main causes of delayed orthopedic surgery are unknown, and our study will be able to tell the circumstances that are the root causes of orthopedic emergency surgery delays.

2.3 Classification of orthopedic emergencies.

Patients are classified into 3 groups based on the urgency of surgery need, using a modification of the method employed by Lankester et al, as expanded to include non-trauma cases:[7,8].

Group A: Open fractures, dislocations, limb injuries associated with vascular compromise, compartment syndrome, acute osteomyelitis, acute septic arthritis, and others who should have treatment within 6 hours of admission.

Group B: Hip fractures, closed long bone fractures, ankle fractures, limb gangrene, removal of severe implant infection, and others who should be operated on day they presented or on the day they are declared fit for surgery.

Group C: Tendon injuries, simple hand fractures, cold abscesses, limb deformities requiring surgical correction, mal-union or non-union of fractures, chronic osteomyelitis, carpal tunnel syndrome, and other cases who should be operated on within 5 days or more of presentation.

The evaluation of delay is a problem on its own. The surgical waiting time is usually defined as the time between admissions to the time of surgery. However, this may be misleading when assessing delays, since patient work up is usually a requirement in order to determine the potential risks and benefits of the proposed surgery[13].

CHAPTER III. METHODOLOGY OF THE STUDY.

3.1 Study Settings

This study was conducted at the University Teaching Hospital of Kigali (CHUK), in the department of Accident and Emergency and Orthopedic Surgery Unit. CHUK is located in Nyarugenge, one of the districts of Kigali and it serves as the largest referral hospital of the country. CHUK is a 519 bed capacity hospital and it provides healthcare, trainings as well as research and support to other hospitals[6]. A wide range of surgical procedures are done on daily basis in this hospital, and most of the emergency trauma procedures performed at this institution (84.2%) are orthopedic procedures.[10]

3.2 Study design

This study was a cross-sectional, prospective study whereby the data on delays in emergency orthopedic surgical procedures were evaluated and used to assess and determine factors that are associated with those delays.

3.3 Patient recruitment

This study was a single center study that was carried out between October 2019 and March 2020. Orthopedic trauma patients in emergency department were recruited in this study after explaining to them about the study and signing the consent form. Patients were recruited at the Accident and Emergency and followed up to the time of surgery.

The recorded data included patient's age, gender, the referring health facility, insurance and primary diagnosis and comorbidities. The amount of time taken from admission to surgery was recorded. Delay was assessed according to the Lankester classification of the orthopedic trauma emergency cases[8], and investigations about the possible causes were carried out, by taking into account the patient and institutional related factors.

Data on variables related to the delay from emergency to theater was recorded each day on every recruited patient by an orthopedic resident, and it included an interview to the hospital staff about the reasons of delay to surgery of a patient. A questionnaire that would be filled by the researcher was used as a data collection tool.

3.4 Study population

Pediatric and adult patients who presented at the emergency of CHUK, with orthopedic trauma related complaints that need emergency or urgent surgical operations.

3.5 Study duration

This study was done during the period from October 2019 and March 2020.

3.6 Selection criteria

3.6.1 Inclusion criteria

In this study we recruited pediatric and adult patients who were admitted through the Accident and Emergency department of CHUK during the study period, and were requiring orthopedic emergency surgical intervention as decided and noted in the file by the orthopedic resident and the orthopedic surgeon on call.

3.6.2 Exclusion criteria

- Patient who refused to consent or assent for this study participation.

3.7 Sampling procedure

All patients admitted through the emergency with orthopedic conditions which required operative intervention in theater for treatment as noted in the file by either the orthopedic surgeon or the orthopedic resident on call were recruited within the research period. A consent/assent form was obtained. We used convenience sampling, where patients fulfilling inclusion criteria were recruited to get the number required as calculated with our sample size estimation.

3.8 Sample size estimation

Data from the article By Robin T. Petroze et al, estimating the operative disease prevalence in Rwanda estimated our prevalence of operative condition to be 6.4%[35]. The acceptance

precision for this research is 0.05. A simple random sample will be computed using the formula:

$$n = Z^2\, P(1-P)/D^2$$

Where:

- n: Sample
- Z: Confidence level of 95% corresponding to 1.96 standardized normal distribution value.
- p: percentage picking a choice, equivalent to 6.4%
- D: Desired study precision; equivalent to 0.05

The formula gives 92 patients who would be recruited for this study. However, there is always a non-zero probability of missing data due to empty or incomplete case report forms. Therefore, 20 % from 92 patients, equivalent to 17 patients were added to give overall sample size of 109 patients.

3.9 Study variables

3.9.1 Dependent variables

The outcome variable for this study was patient delay at emergency department that is a binary variable stating whether the patient's surgery was delayed or was not delayed. The delay was measured referring to the time of patient's trauma to the intervention in relation to the classification of that orthopedic emergency, thus it was categorized into the three delays model:

- Time to seeking care is: interval between injury time and arrival to a primary health facility where the patient seeks care.
- Time to reaching care is the time interval the patient spends between injury time and reaching the accident and emergency department of CHUK where orthopedic surgical care is given.

- Time to receiving care is the interval time the patient spends between injury time and orthopedic surgery being carried out for his/her condition.

3.9.2 Independent variables

The independent variables were grouped into socio-demographic and clinical variables. The socio-demographic variables included: age, gender, residential district, health insurance status and category and main occupation. The clinical variables comprise with time in hours from injury to emergency department, diagnosis at emergency, classification of urgency of surgery, cause of injury, theater slot status, investigations status, implant status, financial means status, health insurance status.

3.10 Data analysis

Descriptive statistics such as frequency, percentages, mean, and graphs were produced prior to the analysis aiming at investigating the factors associated with delays of surgical orthopedic patients in emergency department. This was followed by multiple logistic regressions to investigate the significance and magnitude of association between outcome variable and the covariates. The final model was obtained using stepwise backward model selection approach. The final model's goodness of fit was as well evaluated using Hosmer Lemeshow statistical test. All statistical tests were performed at 5 % significance level. All the above data analysis tasks were carried out using Stata version 13. However, the data entry and cleaning was performed using SPSS version 23.

3.11 Ethical considerations

Confidentiality was ensured at all levels from patients' recruitment to reports of results. The data were protected from inconvenient access by keeping them in a password protected computer accessible only to the research team. New identification codes were generated to replace participants' usual hospital identification numbers in order to keep their anonymous status and privacy at a needed level.

All participants were given explanations about the study and a consent form was voluntarily signed by the patients who were accepting to participate in this study. There was no

remuneration of any kind associated with participation in this study, and there were no risks to the patient except for the time taken to give the interview. Patients were free to withdrawal from the study at any time depending on their will.

This study was approved by University of Rwanda, College of Medicine and Health Sciences, while the permission to collect the data was obtained from CHUK.

CHAPTER IV. RESULTS.

We included 112 orthopedic trauma patients who were received at the Accident and Emergency of CHUK.

Our results were grouped into: Demographic characteristics of patients, Injury characteristics, Delay status between injury and care, and relationship between delay to surgery and other factors.

4.1 Demographic characteristics of patients

Table 1: Demographic variable for study participants

Variable	Frequency	%
Sex		
Female	31	27.68
Male	81	72.32
Age category		
1-15 years	21	18.75
16-30 years	30	26.79
31-45 years	40	35.71
46-60 years	14	12.5
61 years or above	7	6.25
Health Insurance		
Yes	82	73.21
No	30	26.79
Ubudehe category		
Category I	13	12.15
Category II	36	33.64
Category III	57	53.27
Category IV	1	0.93
District of residence		
Gasabo	29	26.36
Nyarugenge	30	27.27
Kicukiro	11	10
Outside of Kigali.	40	36.36
Main occupation		
No Occupation	22	19.82
Subsidence farming	13	11.71
Business	25	22.52
civil servant	12	10.81
Private agent	39	35.14

In the above table, we found that more trauma patients were males (72.32%). The mean age of presentation was 31.9 (SD 17.7). Patient between 31-45 years had the highest likelihood of having an emergency orthopedic injury (35.71%). Patients with medical insurance were 73.21%. The majority of received cases come from the 3 districts of Kigali (63.64 %).

4.2 Injury characteristics

Table 2: Description of Injury characteristics and related variables

Variable	Frequency	%
Cause of Injury		
RTA from Motorcycle vs. Motor vehicle	35	31.25
RTA from Motor vehicle vs. Motor vehicle	7	6.25
RTA from Motorcycle vs. Motorcycle	22	19.64
Fall from height	31	27.68
Object cuts	7	6.25
Other	10	8.93
Primary health facility		
CHUK	55	49.11
District hospital	27	24.11
Health center	30	26.79
Immediate transfer to CHUK		
Yes	91	81.25
No	21	18.75
Transport Mode to CHUK		
Ambulance	36	32.43
SAMU	43	38.74
Private transport	32	28.83
Day of arrival		
Weekend	39	36.45
Working day	68	63.55
Body part		
Lower Limb	80	72.73
Upper Limb	23	20.91
Other	7	6.36
Diagnosis		
Open fracture	57	51.35
Closed fracture	54	48.65
Injury Lankester classification		
Group A	67	60.36
Group B	41	36.94
Group C	3	2.7
Isolated injury vs multiple injuries		
Isolated injury	91	81.25
Multiple injuries	21	18.75
Theater attendance challenge		
No challenge	18	16.07
Lack of theater slot	49	43.75
Lack of health insurance	24	21.43
Lack of theater equipment	21	18.75

Assessing the injury characteristics in the table 2, the majority of patients were motorcycle accident victims (51%). Most of trauma orthopedic emergencies are brought to CHUK by SAMU (38.74%). Lower limb was involved in 72.73% of cases, and the number of open injuries is comparable to closed injuries (51.3% vs. 48.6 %). The majority of injuries are group A emergency (60.3%) using the Lankester classification. Most of the injuries are isolated injuries (81.25%). The main challenge orthopedic emergency cases face to access theater is lack of theater slot (43.75%) followed by the lack of health insurance (21.43%). There is only a minority of patients who met no challenges in accessing theater (16%).

4.3 Timing between injury and receiving care

Table 3: Time in days from injury to receiving care per Fracture characteristics

	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)
Open fracture	57 (51.35)	<1 (<1)	<1(0-36)	2 (0-37)
Closed facture	54 (48.65)	<1(0-1)	<1(0-28)	4 (0-39)
Total	111 (100)	<1(0-1)	<1(0-28)	3 (0-39)

The table above shows that on average, a patient with an open fracture will get orthopedic surgical treatment in 2 days while a patient with a closed fracture will get treated in 4 days.

Table 4: Time in days from injury to receiving care in relation to injured part of the body.

variable	Frequency (%)	Mediantime to seeking care in days	Median time to reaching care in days	Median time from injury to receiving care in days (Min-Max)
Lower Limb	80(72.73)	<1 (0-1)	<1(0-28)	3 (0-39)
Upper Limb	23 (20.91)	<1(0-1)	<1(0-2)	3 (1-37)
Pelvis	7 (6.36)	<1(<1)	<1(0-36)	3 (0-37)
Total	110 (100)	<1(<1)	<1(0-36)	3(0-39)

In the above table, we see that in general, patient with lower limb ,upper limp and pelvic injuries are generally surgically treated on day 3 of injury.

Table 5: Average time in days from injury to receiving care vis-a-vis theater access challenges

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 (0-13)
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)

From this table we can see that patients without theater access challenges spend on average 1 day before they are operated on, while those who miss a theater slot for operation (majority of orthopedic patients counting 43.75 % of cases) delay about 3 days waiting for availability of theater slot. Patients who lack health insurance and funds take longer to reach the tertiary health facility (4.5 days) compared to the other patients. Patients with other challenges like lack of implan or lack of sterile equipment were a fewer number (18.75 % of cases) but they had the greatest delay time in the emergency rooms waiting for surgery(about 4 days).

4.4 Surgical Operation Delay Statuses

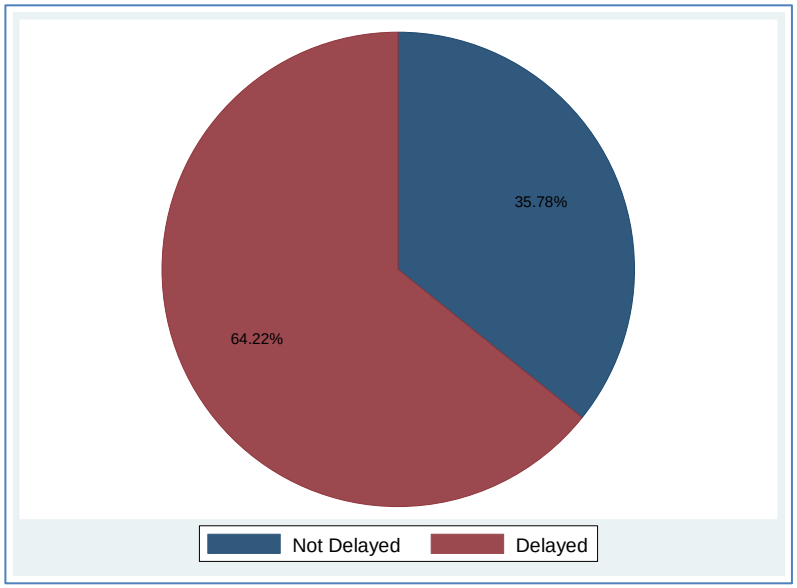


Figure 1: Surgical Operation Delay Statuses

The figure 1 shows that the total number of emergency orthopedic surgeries delays account for 64.22%.

Figure 2: Surgical Operation Delay Status and the Day of Arrival at CHUK

The Figure 2 demonstrates that the number of delayed operations slightly increases in weekend admissions and slightly decreases in week days admission.

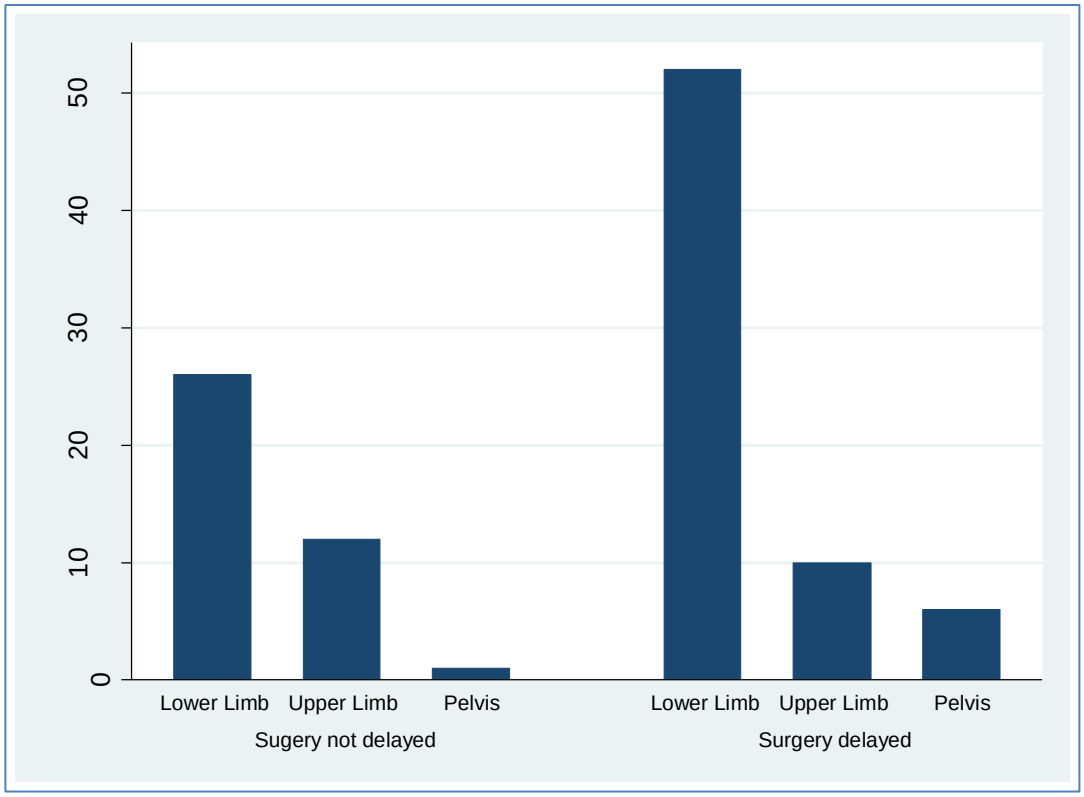


Figure 3: Surgical operation delay status and involved part of the body

The figure3 shows that patients with lower limb injuries make the largest number of patients in general. They are also those whose delayed surgeries make the biggest number, followed by those with upper limb injuries.

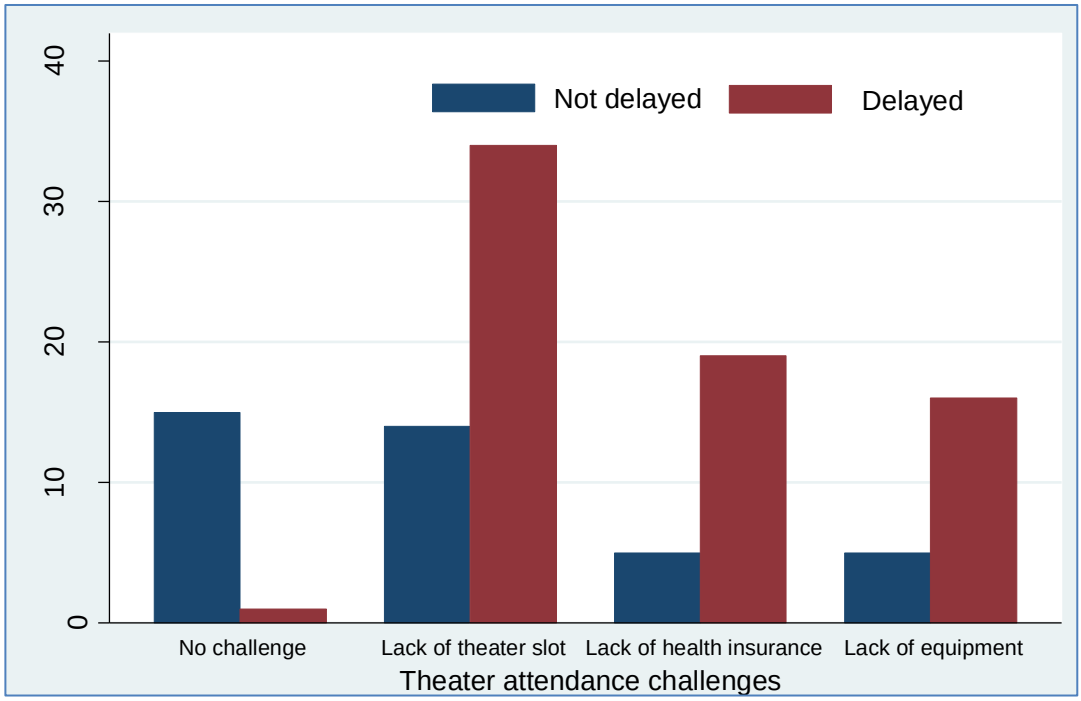


Figure 4: Surgical operation delay status and theater attendance challenge

The figure4 shows that the biggest challenge associated delaying patients' access to theater therefore delaying surgeries are the lack of theater slots followed by the lack of health insurance. Other challenges like lack of implant, lack of experienced surgeon, or associated life threatening injury or any other problem that would delay surgery were also significantly delayed compared to the patients who did not show any challenges to theater access.

4.5 The relationship between surgery delay and other factors

The two tables below show the results of bivariate analysis using Chi-square test between delay status and each of independent variable in each of the tables.

Table 6: Delay to surgical operation and demographic factors

Variable	Not Delayed	Delayed	P-value
Gender			0.865
Female	10	19	
Male	29	51	
Age category			0.245

0-15 years	12	11	
16-30 years	14	28	
36-54 years	9	25	
years or above	4	6	
Health Insurance possession			0.034
Yes	33	46	
No	6	24	
Ubudehe category			0.367
Category I	4	9	
Category II	10	25	
Category III	22	33	
Category IV	1	0	
District of residence			0.255
Gasabo	12	16	
Nyarugenge	11	19	
Kicukiro	1	10	
Out of Kigali	14	24	
Main occupation			0.298
No occupation	3	6	
Subsidence farming	6	6	
Business	5	19	
Public servant or private agent	23	36	

This table shows the results of bivariate analysis using Chi-square test between delay status and each of independent variable in the same table. We can see that only the health insurance possession looks to be significantly involved in delaying emergency orthopedic patients from having surgical treatment.

4.6 Multivariable analysis of the association between delay to surgical operation and other factors

The Table8 provides the results of logistic regression for surgical delay status versus other study covariates. It contains the full model containing all covariates and reduced model containing only significant independent variables reached using 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. It was found that the accuracy was only at acceptable level for theater attendance challenges. The final model (reduced model) was found to be a good fit to the data using Hosmer-Lemeshow test (df=7, goups=9, Chi2=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.

Table 7: Logistic regression model for the delay of surgical operation and study covariates

	Full Model			Reduced Model		
Variable	OR	P-value	95 % CI	OR	P-value	95 % CI
Sex						
Female	1.00					
Male	0.44	0.510	0.04-5.10			
Age category						
1-15 years	1.00					
16-30 years	4.53	0.456	0.09-240.19			
31-45 years	7.21	0.211	0.33-159.61			
46-60 years	28.81	0.070	0.76-1089.05			
61 years or above	5.10	0.580	0.02-1651.85			
Health insurance possession						
yes	1.00					
No	4.30	0.386	0.16-116.05			
Ubudehe category						
Category I	1.00					
Category II	4.45	0.518	0.05-410.80			
Category III	0.59	0.813	0.01-47.77			
Residence District						
Gasabo	1.00					
Nyarugenge	1.25	0.873	0.08-19.18			
Kicukiro	812.00	0.046	1.11-591728.80			
Out of kigali	13.46	0.126	0.48-377.15			
Primary Healthcare Facility						
CHUK	1.00					
District hospital	1105.66	0.006	7.47-163651.70			
Health center	9.27	0.338	0.10-883.79			
Immediate transfer to CHUK						
Yes	1.00					
No	0.97	0.985	0.03-30.92			
Mode of Transport to CHUK						
Ambulance	1.00					
SAMU	348.99	0.014	3.23-37703.34			
Private transport	3.63	0.431	0.15-89.87			
Day of arrival						
Weekend	1.00					
Working day	0.10	0.092	0.01-1.47			
Part of the Body						
Lower limb	1.00					
Upper Limb	1.42	0.813	0.08-25.67			
Other	100.00	0.141	0.22-45948.56			

Variable	Full Model			Reduced Model		
	OR	P-value	95 % CI	OR	P-value	95 % CI
Diagnosis						
Open fracture	1.00					
Closed fracture	1746.02	0.010	5.87-519528.30			
Injury classification						
Group A	1.00					
Group B	0.00	0.022	1.52E-06 - 0.35			
Group C	0.00	0.371	3.03E-14 - 11235			
Isolated injury vs multiple injuries						
Isolated injury	1.00					
Multiple injuries	6.53	0.229	0.30678-138.99			
Theater Attendance Challenges						
No challenge	1.00					
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	124.80	P<0.001	10.48-1485.89
Lack of equipment	1411.88	0.004	10.78-184849.7	165.34	P<0.001	12.19-2243.38
Constant	0.00	0.001	0.00-0.00	0.01	P<0.001	0.00-0.13

In the above table portraying the logistic regression model for the delay of orthopedic surgery with all other study covariates, we can see that only the section concerning theater attendance challenges shows 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. Some patients with other challenges like lack of implants, lack of experienced surgeon, lack of sterile equipment, or associated life threatening injury were significantly delayed compared to the patients who did not show any challenges to theater access with a P<0.001.

CHAPTER V. DISCUSSION

This was a cross-sectional study, designed to quantify the delays to surgical treatment of orthopedic emergency cases received at CHUK and investigate the factors associated with those delays.

In our study ,we found that most of the emergency orthopedic trauma cases were males (72%) and the majority of cases were in the age group of 31-45years (35.71%), mean age being 31.9(SD 17.7) . 63.64 % were coming from inside the capital city, Kigali. Our results were similar to the findings in The study by Jagiasi J. et al[36], looking at the causes of delay in surgical treatment of trauma cases at an urban tertially referral hospital in Mumbai, India. They found that the majority of received cases were males (78%) while the average age was around 42 years. Our results are also comparable to those found by Ifesanya et al.[7] at the University college hospital , Ibadan , Nigeria, looking at the orthopedic surgical treatment delays at a tertially referral hospital. They found that the majority of received cases were males (M:F ratio 1.3) and the mean age was 36.9(SD 19.2). In our study, we found that the RTA was the major cause of orthopedic emergency causalities. Our study results were in concordance with the report on Road safety status globally by the WHO , stating that injuries, especially the road traffic injuries are currently ranking the top cause of deaths in the young adults, but the problem is even worse in the low and middle income countries, where the transport system is increasingly getting motorized.[3].

In general, we found that 64.22 % of our emergency orthopedic patients are delayed to get surgery. Delays are common in developing countries like ours. India, is a good example where the delays of orthopedic emergency cases commonly occurs and most of the circumstances around surgical delays were similar to those we encounter in our settings, as described in a study about delay in surgical orthopedic trauma patients by Jagiasi J et al.[36] who identified that 48% of cases were delayed because of lack of infrastructures, including operating theater slots. In our study we found that 48.57 % of all delayed cases were delayed because of lack of theater slot. For a hospital serving as referral center of 19 district hospitals and thereby serving almost half of the country's population[6], taking into account that there is usually no available orthopedic surgeon at the district hospitals, it can mostly be explained by a discrepancy between the high hospital demands compared to the available capacity of the

institution. Ifesanya et al. in Nigeria found the similar finding at his institution. Lack of theater slot was the number one cause of orthopedic emergency surgery delays (close to 36% of their study population) [7]. According to Mpirimbanyi et al. in their study defining the 3 delays in referral of surgical emergencies at CHUK, this problem may be associated to limited workforce in surgery and anesthesia as well as inadequate infrastructures[6].

The greatest time in delayed emergencies is spent at the Accident and Emergency of CHUK, where patients wait for 4.7 days on average to get the appropriate surgical care. This is a common finding in developing country referral hospitals. We found almost similar to the findings by Ifesanya et al in Nigeria, where they found that the median delay to surgery was 4 days[7]. 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 orthopedic trauma cases do not pass through the normal transfer channel as indicated by Mbanjumucyo et al.[10]. According to this study, trauma patients in Rwanda immediately come to the tertiary hospital, bypassing the primary and secondary health care facilities. This means that the tertiary hospital should have an established mechanism to deal with volumes of trauma patients, yet we found that they are challenges against timely surgical care for these patients.

Lack of health insurance was found to be a major patient related factor delaying treatment at CHUK, in cases of emergency orthopedic surgery. We found that being delayed when an emergency orthopedic patient does not have insurance presents with OR =227.59 compared OR=1 when there is no challenges to theater access. In our study, we found that 27 % of all delayed cases were delayed because of lack of health insurance. Patient 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. (about 25% of orthopedic emergency cases)at the University College Hospital , Ibadan ,Nigeria[7], which was almost similar to our results (27% of emergency orthopedic cases).

The delay in orthopedic surgical treatment of trauma orthopedic emergency cases at CHUK did not have any relationship with the modified Lankester classification of injuries (P=0.179). In our study, we found that the majority of cases were classed as Group A (67% of our study population) and we found that being classed as group B or C did not significantly affect the surgical delay noted in trauma patients. This was different in the study by Ifesanya et al. in Nigeria, where the modified Lankester classification significantly influenced the delay tendencies (0.003)[7]. in their study, Ifesanya et al. found that delay increases from group A (34.1% of their study population) to group B and C respectively[7], meaning that at their institution, priority was first given to the group A trauma patients. The difference in the number of group A patients may be explained that, for us we considered patients who were only admitted from the emergency department, while in their study, Ifesanya et al. included other admission portals like the outpatient's clinic. In our study, the mean time to get operated without theater access challenges was 2.2 days. These were a few patients who were either in Group B or C and had to get stabilized at the emergency before they get operated on. We found that close to half of emergency orthopedic injuries (51.35%) received at CHUK during our study period were open fractures and would be in group A of the Lankester classification. However, 59.6% of these open fractures were delayed to have surgical treatment, while nearly half (46.2%) of closed fracture injuries received treatment on time. We find this to be due to multiple reasons, including organizational issues in the orthopedic team, mainly not using a routine classification of the casualties in emergency groups in order to establish a patient flow system while allocating theater time as suggested by Villa et al[37]. We also found a minority of patients (16.07%) who had no theater access challenges, and they were mainly operated on time. we found the same findings as found in other developing countries like India, where the study by Jagiasi J et al. about delay in surgical management of orthopedic trauma patients found that only 14.28 % were operated on time. this could still be explained by the discrepancy between insufficient infrastructure/personnel and large volume patients.

In our study, other major institution related factors delaying surgery access affected 21% of all delayed cases. These were mainly insufficiency of sterile linen and gowns, lack of necessary implants and other problems related to the organization of the hospital, like, patient delaying to reach the theater area during the work shifting hours, when the day team is being replaced by a night team of hospital staff. Waiting for an experienced consultant surgeon

when a patient is received after the normal office hours was also an issue in some instances. Unavailability of surgeon or theater affected 29% of emergency orthopedic cases in the study by Orosz in study conducted in 4 hospitals in New Yolk [29], and organizational reasons delayed 29% of emergency patients in the study by Youde et.al , in England[32]. Lack of implants affected 7% of emergency orthopedic 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 J. et al, in India[36]. This tells us that organizational issues might be occurring both in the developed and in the developing countries, but the infrastructure and equipment problems are more profound in the developing word and these contribute significantly to delaying surgical treatment of orthopedic emergency causalities.

During our study, we had some limitations. This study described only patients received through the emergency department portal at the one center, CHUK, and does not properly reflect delays happening in orthopedic emergency patients received through all of the admission portals of CHUK, and it might not well represent the current status of orthopedic emergency delays in the country. Our study found a group of a few patients who had theater access challenges grouped in other challenges. These were lack of implant, lack of experienced surgeon, lack of sterile equipment or associated life threatening injury. These patients were a small number in each of the subgroups (<5 patients) and it would not be possible to assess each patient independently, however, this group was significantly delayed compared to the group of patients who did not show any challenges to theater access. Our study included only patient whose intervention was done in theater of CHUK, yet some emergency orthopedic patients are managed and discharged at the emergency department and these are not represented in this study. Our study did not include any orthopedic emergency patient who might have died before reaching the theater for intervention. 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 orthopedic emergency patients treatment would be of a great value.

CHAPTER VI. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study was conducted to establish factors associated to surgical delays in emergency orthopedic surgeries of patients received at CHUK, the biggest referral hospital in country. We have 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 challenges in theater access contributing to the majority of the delays. The lack of theater slots as well as insufficiency of equipment, including hospital supplies like implants and sterile linen contributed a lot to delaying surgeries in orthopedic trauma patients.

6.2 Recommendations

In our study, we found that patients were likely to be delayed if they did not have a health insurance. For this reason we would like to recommend to the Ministry of Health and other concerned bodies:

1. To make better programs in public sensitization on using the community health insurance scheme (mutuelle de santé). Given a high demand of the orthopedic emergencies, we would also like to recommend the concerned bodies of the Government and CHUK to find a way

2. To increase infrastructures and staff not only at CHUK, but also at the district hospitals,

3. To carry out an extended study on a better usage of available resources and personnel so as to decrease the number of patients who are delayed to access orthopedic surgical treatment.

REFERENCES

1. Yamuragiye A, Ibambasi A, Mutuyimana A, Mutuyemariya O, Nsereko E. Short communication Injury Profile in an Emergency Department at a Referral Hospital in Kigali, Rwanda. Rwanda j Heal sci. 2013;2(1).

2. Kisitu DK, Eyler LE, Kajja I, Waiswa G, Beyeza T, Ragland DR, et al. The role of Ugandan District Hospital orthopedic units in the care of vulnerable road users: a cross-sectional study. Inj Epidemiol. 2016;3(1).

3. World Health Organization. GLOBAL STATUS REPORT ON ROAD SAFETY [Internet]. Geneva: Word Health Organization; 2018. 1–23 p. Available from: https://apps.who.int/iris/bitstream/handle/10665/276462/9789241565684-eng.pdf

4. Gosselin RA, Spiegel DA, Zirkle LG. Editorials Injuries : the neglected burden in developing countries. Bull World Heal Organ [Internet]. 2009;(May):8–10. Available from: https://www.researchgate.net/publication/26315651

5. Yunus S, Kauser S, Ali S. Three ‘ Delays ’ as a Framework for Critical Analysis of Maternal Near Miss and Maternal Mortality. J South Asian Fed Obstet Gynecol. 2013;5(August):57–9.

6. Mpirimbanyi C, Abahuje E, Dieudone A, Miguel H, 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):1871–9. Available from: https://doi.org/10.1007/s00268-019-04991-3

7. Ifesanya A, Ifesanya J, 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.

8. Lankester BJA, Paterson MP, Capon G, 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):322–6.

9. Mbanjumucyo G, DeVos E, Pulfrey S, Epino HM. State of emergency medicine in Rwanda 2015: An innovative trainee and trainer model. Int J Emerg Med [Internet]. 2015;8(1):2–4. Available from: http://dx.doi.org/10.1186/s12245-015-0067-2

10. Mbanjumucyo G, George N, Kearney A, Karim N, Aluisio AR, 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):191–7. Available from: http://dx.doi.org/10.1016/j.afjem.2016.10.001

11. Beebe AC, Arnott L, Klamar JE, Kean JR, Klingele KE, Samora WP. Utilization of Orthopaedic Trauma Surgical Time: An Evaluation of Three Different Models at a Level I Pediatric Trauma Center. Orthop Surg. 2015;7(4):333–7.

12. Simunovic N, Devereaux PJ, Sprague S, Guyatt GH, Schemitsch E, DeBeer J, et al. Effect of early surgery after hip fracture on mortality and complications: Systematic review and meta-analysis. Cmaj. 2010;182(15):1609–16.

13. McIsaac DI, Abdulla K, Yang H, Sundaresan S, Doering P, Vaswani SG, et al. Association of delay of urgent or emergency surgery with mortality and use of health care resources: A propensity score-matched observational cohort study. Cmaj. 2017;189(27):E905–12.

14. 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).

15. Ahmed G, Shiraz S, Riaz M, Ibrahim T. Late versus early reduction in traumatic hip dislocations: a meta-analysis. Eur J Orthop Surg Traumatol. 2017;27(8):1109–16.

16. Hull PD, Johnson SC, Stephen DJG, Kreder HJ, Jenkinson RJ. Delayed debridement of severe open fractures is associated with a higher rate of deep infection. Bone Jt J. 2014;96 B(3):379–84.

17. Kanji A, Atkinson P, Fraser J, Lewis D, 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):130–3.

18. Nielsen E, Skaggs DL, Harris LR, Andras LM. Transfer Time After Acceptance to a Level I Trauma Center. JAAOS Glob Res Rev. 2018;2(2):e081.

19. Ezeanya Esiobu C. The rise of homegrown ideas and grassroots voices: New directions in social Policy in Rwanda. United Nation Res Inst Soc Dev [Internet]. 2017;6(2017–6):13–5. Available from: http://hdl.handle.net/10419/186097

20. Bilal BS, Abdellah EM, Lina C, Oussama B, Ghazi BS. Operating Room Management System: Patient Programming. MATEC Web Conf. 2019;281:05004.

21. Caesar U, Karlsson J, Hansson E. Incidence and root causes of delays in emergency orthopaedic procedures: A single-centre experience of 36,017 consecutive cases over seven years. Patient Saf Surg. 2018;12(1):1–10.

22. North JB, Blackford FJ, Wall D, Allen J, Faint S, Ware RS, et al. Analysis of the causes and effects of delay before diagnosis using surgical mortality data. Br J Surg. 2013;100(3):419–25.

23. Mohtasham H, Safdari F, Joint B, Aliahmadi A, Qoreishi M. Epidemiology Orthopedic Injuries Referring to Emergency Department A Cross Sectional Study Epidemiology Orthopedic Injuries Referring to Emergency Department A Cross Sectional Study Introduction Orthopaedic injuries are important causes of referral to hea. Iran J Orthop Surg. 2018;16(3):302–6.

24. Giannoudis P V., Papakostidis C, Roberts C. A review of the management of open fractures of the tibia and femur. J Bone Joint Surg Br. 2006;88-B(3):281–9.

25. Novack V, Jotkowitz A, Etzion O, Porath A. Does delay in surgery after hip fracture lead to worse outcomes? A multicenter survey. Int J Qual Heal Care. 2007;19(3):170–6.

26. Singh J, Rambani R, Hashim Z, Raman R, Sharma HK. The relationship between time

to surgical debridement and incidence of infection in grade III open fractures. Strateg Trauma Limb Reconstr. 2012;7(1):33–7.

27. Dexter F, Abouleish AE, Epstein RH, Whitten CW, Lubarsky DA. Use of operating room information system data to predict the impact of reducing turnover times on staffing costs. Anesth Analg. 2003;97(4):1119–26.

28. Fantini MP, Fabbri G, Laus M, Carretta E, Mimmi S, Franchino G, et al. Determinants of surgical delay for hip fracture. J R Coll Surg Edinburgh Irel [Internet]. 2011;9(3):130–4. Available from: http://dx.doi.org/10.1016/j.surge.2010.11.031

29. Orosz GM, Gilbert M, Aufses A, Straus E, Vespe E, Siu AL, et al. Hip fracture in the older patient: Reasons for delay in hospitalization and timing of surgical repair. J Am Geriatr Soc. 2002;50(8):1336–40.

30. Kajja I, Sibinga C Th S. Delayed elective surgery in a major teaching hospital in Uganda. Int J Clin Transfus Med. 2014;1.

31. Shiga T, Wajima Z, Ohe Y. Is operative delay associated with increased mortality of hip fracture patients? Systematic review, meta-analysis, and meta-regression. Can J Anesth. 2008;55(3):146–54.

32. Youde J, Husk J, Lowe D, Grant R, Potter J, Martin F. The national clinical audit of falls and bone health: The clinical management of hip fracture patients. Injury. 2009;40(11):1226–30.

33. Charalambous CP, Yarwood S, Paschalides C, Siddique I, Hirst P, Paul A. Factors delaying surgical treatment of hip fractures in elderly patients. Ann R Coll Surg Engl. 2003;85(2):117–9.

34. Dinah AF. Reduction of waiting times in A&E following introduction of "fast-track" scheme for elderly patients with hip fractures. Injury. 2003;34(11):839–41.

35. Petroze RT, Groen RS, 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):457–64. Available from: http://dx.doi.org/10.1016/j.surg.2012.10.001

36. Jagiasi J, Prasad A, Naisbitt A, 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):1762–6.

37. Villa S, Barbieri M, Lega F. Restructuring patient flow logistics around patient care needs: Implications and practicalities from three critical cases. Health Care Manag Sci. 2009;12(2):155–65.

APPENDICES

Appendix1. Informed consent/Assent form (English version)

Name of Research: Factors associated with treatment delays in orthopedic trauma patients attending the Accident and Emergency Department of the University Teaching Hospital of Kigali.

Principal Investigator: Dr Emile Turatsinze, medical doctor and resident in Orthopedics.

Our research requires participation of Patients who will be admitted as emergency orthopedic cases at CHUK, and require orthopedic intervention requiring any form of anesthesia during the study.

- I am inviting you to participate in this research. You do not have to decide now, whether or not you may participate in the research. Before you decide, you can talk to anyone you feel comfortable with.
- Your decision for participation in this study is entirely voluntary. If you choose not to consent, they will be no change to services you will receive at this hospital. You may also choose to change your mind later and stop participating.
- If there are words that you do not understand, I will take time to explain. If you have questions later, you can ask them to me.

- Orthopedic surgery delay is a concerning issue in locally and worldwide. At our institution, we do not have data concerning orthopedic surgery delays. The purpose of this research is to get those data at CHUK.
- We are going to ask you questions about how you ended in this emergency of CHUK, and we will try to identify whether your treatment was carried out on time or late. If late, we will see reasons why it was delayed.
- The risk to participant is minimized; you will be managed according to the usual CHUK protocols.
- You will not be provided any incentive to take part in this research.
- The information that we collect from this research project will be kept confidential. Any information about you will have a number on it instead of your name.
- The knowledge that we will get from this study will be shared with you before it is made widely available to the public.
- There may be some words you don't understand or things that you want me to explain more about. Please ask me and I will take time to explain.

Dr. Turatsinze Emile, Mobile: 0788954184

Dr. Rutayisire Lambert, Mobile: 0788765779

Prof. Byiringiro J. Claude: Mobile: 0788868240

Contacts from CMSH-IRB

- Chairperson of the CMHS IRB, Mobile: 0788490522
- Deputy Chairperson of the CMHS IRB, Mobile: 0783340040

Certificate of Informed Consent

I have read this information (or had the information read to me). I have had my questions answered and know that I can ask questions later if I have them. I agree to take part in the research.

Name and signature of participant:

_____

Date:_____

If illiterate:

I have witnessed the accurate reading of the consent form to the participant/guardian. I confirm that the individual has given consent freely.

Name and signature of witness _____

Thumb print of participant/guardian

Date:_____

Statement by the researcher/person taking consent

I confirm that the participant/guardian was given an opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly. I confirm that

the individual has not been coerced into giving consent, and the consent has been

given freely and voluntarily.

Name and signature of Researcher/person taking the consent_____

Date _____

Appendix 2. Informed consent/Assent form (Kinyarwanda version)

Inyito y'ubushakashatsi: Factors associated with treatment delays in orthopedic trauma patients attending the Accident and Emergency Department of the University Teaching Hospital of Kigali

Umushakashatsi: Dr Emile Turatsinze, umuganga wiga kuvura indwara z'amagufa

Ubu bushakashatsi burareba abarwayi bivuza indwara z'amagufa banyuze muri serivisi y'ibuvuzi bw'indembe (Emergency care) mu bitaro bya CHUK, bakavurwa hifashishijwe ikinya.

Upupapuro rutangauburenganzira nta gahato

- Twishimiye gusaba ko wowe wadufasha muri ubu bushakashatsi nta gahato. Singombwa ko uhita ufata icyemezo aka kanya. Ushobora no kubanza kubaza ibibazo umuntu uwariwe wese waguha inama.

- Kujya muri ubu bushakashatsi kwawe, ni kubushake kandi nta gahato. Uramutse utabyemeye, ntampinduka zizaba kuri serivisi ibitaro biguha. Ushobora no guhindura icyemezo igihe cyose ubyumva kabone niyo ubushakashatsi bwaba bwatangiye.

- Hari amagambo agoye kumva, ariko ndayagusobanurira, kandi nibindi bisobanuro byose ucyenera ubimbaze ndabiguha

- Gutinda kubagwa uburwayi bw'amagufa ni ikiazo gitera guhangayika mu karere dukoreramo, ndettse no ku isi muri rusange. Mu bitaro byacu, nta mibare dufite igaragaza urugero rwo gutinda kubagwa kubarwayo tuvura. Ubu bushakashatsi bugamije kubona iyo mibare muri chuk.
- Turakubaza ibibazo bijyanye n'ubyo wageze kuri iyi nzu y' indembe (urgencies) mu bitaro bya CHUK. Turareba kandi niba ubuzi bwawe bwaba bwarakozwe ku gihe, cyangwa se niba waratinze kuvurwa. Turareba kandi impamvu zaba ratumye utinda

kuvurwa niba byarabaye.Ibyo tukubaza mu bushakashatsi ntangaruka bikugiraho; ubuvuzi urakomeza kubuhabwa hakurijwe amategeko n'amabwiriza agenwa n'ibitaro bya CHUK.

- Ntanyungu zindi zihishe inyuma y'ubu bushakashatsi.
- Amakuru yose ku bushakashatsi tuzayabika mu buryo bwibanga, azamenywa natwe turi mu bushakashatsi gusa.
- Ubushakashatsi niburangira, ibyavuyemo tuzabigaragaza mu binyamakuru bya siyansi kugirango bigirire benshi akamaro.
- ugize amagambo utumva, wambwira nkagusobanurira.
- Ugize icyibazo kubijyanye n'ubushakashashatsi wabaza aba bakurikira:
    - Dr Turatsinze Emile, Mobile: 0788954184
    - Dr Rutayisire Lambert, Mobile: 0788765779
    - Prof. Byiringiro J. Claude: Mobile: 0788868240
    - Abahagarariye ubushakashatsi muriKaminuza y'u Rwanda

    1. Chairperson of the CMHS IRB, Telefoni: 0788490522

    2. Deputy Chairperson of the CMHS IRB, Telefoni: 0783340040

Kwemeza itangwa ry'uburenganzira

Ndemeza ko nasomye / nasomewe ibikubiye muri iyi nyandiko kandi nkanasubizwa neza ibibazo

byose nabajije kubijyanye nubu bushakashatsi. Nemeye kujya muri ubu bushakashatsi ntagahato.

Amazina numukono:

_____

Itariki:_____

Niba atazigusoma:

Nk'umugabo, ndemeza ko umurwayi yahawe ibisobanuro byose ku

bushakashatsi. Ndemeza ko yemeye kujya muri ububushakashatsi nta gahato.

Amazina n'umukono by'umugabo:

_____

Igikumwe cy'umurwayi:

Kwakira uburenganzira

Ndemeza ko umurwayi yahawe umwanya wo kubaza ibibazo

byose ku bushakashatsi kandi ko yahawe ibisubizo bishimije. Ndemeza ko umurwayi yemeye kujya mu bushakashatsi ntagahato ashyizweho.

Amazina n'umukono by'uwakiriye uburenganzira_____

Itariki _____

Appendix 3: Questionnaire

TOPIC: Factors associated with treatment delays in orthopedic trauma patients attending the Accident and Emergency Department of the University Teaching Hospital of Kigali

By : Dr Emile Turatsinze

Ask the patient

1. Identification
2. Age
3. Gender M = Male F = Female
4. Health insurance Y=Yes, N=No
5. Date of injury day/month/year
6. Ubudehe category:
    a. 1
    b. 2
    c. 3
    d. 4
7. District of residence
8. level of education:

    A. no school B. primary school level c. secondary school level university level.

9. Main occupation:
    a. Subsidence Farmer
    b. Business
    c. Moto driver
    d. Motor vehicle driver
    e. Other: specify
10. Date of jury
    a. Dates
    b. Morning time

c. Afternoon time
d. Evening time
e. Night time

11. Cause of injury

1=Unintentional	2=Intentional (specify)
A=RTA Car VS motorcycle Motor vehicle VS Motor vehicle Motor vehicle VS pedestrian Moto vs motorcycle B=fall C=sport participation D=other	

12. Date of Consult
    a. date/month/year
13. have you consulted a health facility immediately?
    a. yes
    b. No

    If Yes, don't answer Q 14

14. Causes of delay in seeking care if any
    a. Consulted a traditional healer.

b. Did not consider the sickness serious enough to warrant consolation.
c. Health facility too far from home
d. Not enough financial means
e. No heath insurance
f. Others

15. What is the consulted Primary health care facility (IF ANY)
    a. Health center
    b. District hospital
    c. Private clinic
    d. Other
    e. CHUK immediately
        i. If CHUK: skip q19
16. Mode of transport to primary health facility
    a. Ambulance
    b. Other: specify

Section B. Ask the transferring nurse(interview) and the transferring doctor By phone

17. Surgical intervention done at the primary health facility
    a. NO
    b. Yes: specify
18. Transferred immediately to CHUK
    a. NO: WHY?
    b. Yes
19. Date / hour/minutes of arrival at CHUK
20. Day of arrival:

DAY	Time of the day
a. Monday b. Tuesday c. Wednesday d. Thursday	a. Morning time b. Afternoon time c. Evening time d. Night time

e. Friday f. Saturday g. Sunday	

21. Mode of transport to CHUK
    a. Ambulance
    b. SAMU
    c. Private car
    d. Other: specify
22. Was the patient you treated transferred soon enough to CHUK? Ask the referring doctor by phone
    a. YES
    b. No (WHY)?
        i. I know the reason? (which one(s))

Section c: Checking file and asking the ortho resident

23. Diagnosis made at CHUK (consult the file made at the A&E)
    a. Open femur fracture
    b. Open tibia& fibula fracture
    c. Open malleoli fracture
    d. Open humerus fracture
    e. Open radius & ulna fracture
    f. Closed femur fracture
    g. Closed tibia& fibula fracture
    h. Closed ankle fracture

i. Closed humerus fracture
j. Closed supracondylar fracture(pediatric
k. Salter Harris fracture
l. Hand injury(specify)
m. Foot injury (specify)
n. Septic arthritis(specify involved joint)
o. Dislocation(specify Joint)
p. Compartment syndrome
q. Pelvic fracture
r. other

24. Part of body 1=Upper limb 2=Lower limb 3= pelvis, 4= other(specify)
25. Associated injuries: Ask the Ortho resident on call

1=Isolated	2=associated injury (specify) a. Head injury b. Abdominal injury c. Chest injury d. other _____

26. Other medical problems ask : the ortho resident on call

Yes	NO
a. Hypertension b. Diabetes mellitus c. Deep venous thrombosis d. Asthma e. none f. Disseminated infection g. Other:……	

27. Time of surgery ortho resident on call on the day of operation

a. Date/hour/minute

---D--/--M--/--Y--/--HR--/--MIN—

28. orthopedic surgical Management: ortho resident on call on the day of operation

A=Closed reduction + percutaneous pinning
B=ORIF
C=OREF
D=Others(specify)

29. Surgical management done within the expected timing according to orthopedic surgeon(question asked in theater, whole team present, at the time of time out)

ortho resident on call on the day of operation

A=Yes	
B=NO	Reason why? A: NO post op Disposition Ward Bed / ICU Bed B: NO theater slot C: patient not stable Hemodynamic instability/ Severe associated injuries/ comorbidities D: no investigations E:no Implants F: no Health insurance G: procedure postponed before: WHY? E: others

Appendix 4: IRB APPROVAL

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 5th /December/2019

Dr TURATSINZE Emile
School of Medicine and Pharmacy, CMHS, UR

Approval Notice: No 523/CMHS IRB/2019

Your Project Title ***"Factors Associated With Treatment Delays In Orthopedic Trauma Patients Attending The Accident And Emergency Department Of The University Teaching Hospital Of Kigali "*** has been evaluated by CMHS Institutional Review Board.

		Involved in the decision		
		Yes	No (Reason)	
Name of Members	**Institute**		**Absent**	**Withdrawn from the proceeding**
Prof Kato J. Njunwa	UR-CMHS	X		
Prof Jean Bosco Gahutu	UR-CMHS	X		
Dr Brenda Asiimwe-Kateera	UR-CMHS	X		
Prof Ntaganira Joseph	UR-CMHS	X		
Dr Tumusiime K. David	UR-CMHS	X		
Dr Kayonga N. Egide	UR-CMHS	X		
Mr Kanyoni Maurice	UR-CMHS		X	
Prof Munyanshongore Cyprien	UR-CMHS	X		
Mrs Ruzindana Landrine	Kicukiro district		X	
Dr Gishoma Darius	UR-CMHS	X		
Dr Donatilla Mukamana	UR-CMHS	X		
Prof Kyamanywa Patrick	UR-CMHS		X	
Prof Condo Umutesi Jeannine	UR-CMHS		X	
Dr Nyirazinyoye Laetitia	UR-CMHS	X		
Dr Nkeramihigo Emmanuel	UR-CMHS		X	
Sr Maliboli Marie Josee	CHUK	X		
Dr Mudenge Charles	Centre Psycho-Social	X		

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 5th December 2019, **Approval has been granted to your study.**
Please note that approval of the protocol and consent form is valid for **12 months**.

Email: researchcenter@ur.ac.rw P.O Box 3286 Kigali, Rwanda www.ur.ac.rw

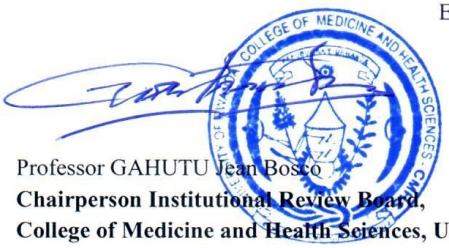
You are responsible for fulfilling the following requirements:

1. Changes, amendments, and addenda to the protocol or consent form must be submitted to the committee for review and approval, prior to activation of the changes.
2. Only approved consent forms are to be used in the enrolment of participants.
3. All consent forms signed by subjects should be retained on file. The IRB may conduct audits of all study records, and consent documentation may be part of such audits.
4. A continuing review application must be submitted to the IRB in a timely fashion and before expiry of this approval
5. Failure to submit a continuing review application will result in termination of the study
6. Notify the IRB committee once the study is finished

Sincerely,

Date of Approval: The 5th December 2019

Expiration date: The 5th December 2020



Professor GAHUTU Jean Bosco
Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Cc:

- Principal College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate Studies, UR

Appendix 5: Budget summary of the project

NAME OF THE PROJECT:Factors associated with treatment delays in orthopedic trauma patients attending the Accident and Emergency Department of the University Teaching Hospital of Kigali

Item	Quantity		Unit cost	total cost
Research assistant	1	1	200,000	200,000
Statistician	1	1	250,000	250,000
internet	1 GB per month	5	1000	5,000
Printing of draft proposal for presentation in the orthopedic department	26 pages X 2 copies	52	50	2,600
Printing of the final copy of the proposal	26 pagesX 1copy	26	50	1,300
Photocopy of the final copy of the proposal	26 pagesX 2 copies	52	20	1,040
Printing of Draft of dissertation	50 pages X 2 copies	100	50	5,000
printing of the dissertation	50 pages x 1 copy	50	50	2,500
Photocopy of the dissertation	50 pages x3 copies	150	20	3,000
Dissemination copies ofdisertation	50 pages X3 copies	150	20	3,000
total cost				473,440