DISSERTATION

FACTORS CONTRIBUTING TO THE OUTCOMES IN ADULT PATIENTS ADMITTED FOR TRAUMATIC BRAIN INJURY (TBI) AT KIGALI UNIVERSITY TEACHING HOSPITAL.

By

Emmanuel TUYISINGIZE

MASTER OF SCIENCE DEGREE IN NURSING SCIENCES (CRITICAL CARE AND TRAUMA SPECIALTY)

COLLEGE OF MEDICINE AND HEALTH SCIENCES
SCHOOL OF NURSING AND MIDWIFERY

Primary Supervisor: M. Providence UMUZIGA
Senior Supervisor: Prof. Adejumo OLUYINKA

June 2017
DISSERTATION

FACTORS CONTRIBUTING TO THE OUTCOMES IN ADULT PATIENTS ADMITTED FOR TRAUMATIC BRAIN INJURY (TBI) AT KIGALI UNIVERSITY TEACHING HOSPITAL.

By

Emmanuel TUYISINGIZE

216337941

A dissertation submitted in partial fulfillment of the Requirements for the

MASTER OF SCIENCE DEGREE IN NURSING SCIENCES (CRITICAL CARE AND TRAUMA SPECIALTY)

In the

COLLEGE OF MEDICINE AND HEALTH SCIENCES, UNIVERSITY OF RWANDA

Primary Supervisor: M. Providence UMUZIGA
Co supervisor: Prof. Adejumo OLUYINKA

June 2017
Declaration

I do hereby declare that this dissertation submitted in partial fulfillment of the requirements for the degree of MASTERS OF SCIENCE in NURSING, at the University of Rwanda/College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

Emmanuel TUYISINGIZE, Registration Number: 216337941

Signature …………………..
Abstract

Background: Traumatic Brain Injury (TBI) is one of the major causes of mortality and disabilities worldwide and its burden to the community ranges from severe disabilities imposing long-term rehabilitation, reduced productivity to high mortality rate. Road traffic accident, falls from height, and other assaults even intentional or unintentional, as well as alcohol involvement, have been reported by different studies as the causes of TBI.

Nowadays, the number of TBIs are increasing in our country but very few and non-published information are available. Therefore, this study was to identify and describe the factors contributing to outcomes of patients with TBI.

Methods: A quantitative, retrospective, and cross-sectional study was conducted on adults patients admitted for TBI at Kigali University Teaching Hospital from 2015 to 2016. A sample of 319 files was selected based on standard TBI inclusion criteria. Data capture sheet have been developed based on different validated clinical models. Using SPSS version 20, collected data were analyzed for frequencies and distribution. Pearson’s Chi², Fisher exact test, and logistic regression analysis were performed to test for correlation and the P value of 0.05 or less was considered significant.

Findings: Findings revealed that age above 60 years old, heart rate above 120 bpm, peripheral oxygen saturation less than 85%, systolic blood pressure less than 75mmHg, Glasgow coma scale 3-5, and bilateral mydriasis were significantly associated with death. Furthermore, Glasgow coma scale less than 9, unilateral myosis, and one reacting pupil were significantly associated with moderate disability, while normal heart rate, peripheral oxygen saturation of 95% and above, mild TBI, normal pupil size and reflexes were significant factors of good recovery outcome.

Conclusion and recommendations: The admission profile of TBI patients influence the outcome at discharge. Nurses and other Clinicians may recognize that the admission assessment of TBI patients should be performed with focus and clinical findings may be interpreted well and used to plan for care and predict patient’s outcome at discharge.
Dedication

I do hereby declare that this dissertation submitted in partial fulfillment of the requirements for the degree of MASTERS OF SCIENCE in NURSING, at the University of Rwanda/College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.
Acknowledgements

I would like to thankfully acknowledge:

The Ministry of Health and the Human Resource for Health (HRH) program for provided opportunities and sponsorship that help me gaining access to this program.

The College of Medicines and Health Sciences for the hard work done to plan and implement this program.

Kabgayi School of Nursing and Midwifery for releasing me to do this course.

My Supervisors: M. UMUZIGA Providence and Prof. Adejumo OLUYINKA for the support, guidance, and collaboration they provided to me in the development of this project.

My colleagues for provided assistance and support,

My Wife and Daughter for day to day support and valuable help offered to me during this period.

Finally, I would like to thank all lecturers in this program for hard work, advice, instructions, and mentorships they provided to me to make this program effective.

Your contributions are truly appreciated!

Emmanuel TUYISINGIZE
**List of abbreviations**

bpm: beats per minute

CSF: Cerebral Spinal Fluid

CT: Computed Tomography

DRS: Disability Rating Scale

FIM: Functional Independence Measures

FSE: Functional Status Examination

GCS: Glasgow Coma Scale

GOSE: Glasgow Outcome Scale Extended

HDU: High Dependent Unit

HRH: Human Resource for Health

ICP: Intra Cranial Pressure

ICU: Intensive Care Unit

PaCO$_2$: Partial Pressure of Carbon dioxide

PTS: Post Traumatic Seizures

QIQ: Community Integration Questionnaire

RTS: Revised Trauma Score

SAMU: Service d’Aide Medicale Urgence

TBI: Traumatic Brain Injury
Table of Contents

Declaration ................................................................................................................................. i
Abstract ..................................................................................................................................... ii
Dedication ................................................................................................................................. iii
Acknowledgements .................................................................................................................... iv
List of abbreviations .................................................................................................................... v

CHAPTER 1: INTRODUCTION ......................................................................................... 1

1.1. Background ......................................................................................................................... 1
1.2. Problem statement ............................................................................................................... 3
1.3. The aims of study ............................................................................................................... 5
1.4. Objectives of the study ....................................................................................................... 5
1.5. Research questions ............................................................................................................ 5
1.6. Significance of the study .................................................................................................... 5
1.7. Operational term definitions ............................................................................................. 6
1.8. The organization of this dissertation ................................................................................ 6

CHAPTER 2: LITERATURE REVIEW .......................................................................... 8

2.1. Introduction ........................................................................................................................ 8
2.2. Theoretical literature around Traumatic Brain injury .......................................................... 8

   2.1.1. Causes and mechanisms of injury ............................................................................... 8
   2.1.2. Pathophysiology .......................................................................................................... 8
   2.1.3. Classification of TBI .................................................................................................... 10
   2.1.4. Clinical manifestations ............................................................................................... 12
   2.1.5. Diagnostic indicators for TBI ..................................................................................... 13
   2.1.6. TBI diagnostic procedures ........................................................................................ 13
   2.1.7. Treatment modalities for TBI .................................................................................... 13
3.15.2. Challenges......................................................................................................................... 27

CHAPTER 4. THE PRESENTATION OF RESULTS ................................................................. 29

4.1. Introduction ........................................................................................................................ 29

4.2. Description of admission and discharge profiles of TBI patients ................................. 29

4.2.1. The profile of TBI patients at admission ................................................................. 29

4.2.2. The profile of patients sustained TBI at discharge. ................................................. 34

4.3. Factors at patient admission associated with discharge outcome................................. 35

4.3.1. The factors at patient’s admission associated with discharge outcomes ............... 35

4.3.2. Factors at TBI patient’s admission associated with severe disability............... 38

4.3.4. Factors at admission associated with moderate disability .................................... 40

4.3.5. Factors at admission associated with good recovery outcome (N=319) .............. 42

CHAP 5. DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS . 44

5.1. The profile of TBI patients at admission to Kigali University Teaching Hospital ...... 44

5.2. The profile of TBI patients at hospital discharge ......................................................... 45

5.3. Factors predicting the outcome of patients admitted with TBI ................................. 46

5.4. CONCLUSION .................................................................................................................. 47

5.5. RECOMMENDATIONS .................................................................................................. 47

References ............................................................................................................................... 49

Appendix I: CERTIFICATE OF COMPLETION FOR PROTECTING HUMAN
RESEARCH PARTICIPANT ............................................................................................................. I

APPENDIX 2. CHECKLIST ....................................................................................................... I

APPENDIX 3. UR/CMHS ETHICAL CLEARANCE ................................................................. IV

APPENDIX 4. CHUK ETHICAL CLEARANCE ....................................................................... V

APENDIX 5. DATA ACCESS PAPER ...................................................................................... VI
LIST OF TABLES

Table 1: The summary of TBI classification as described by M.Silver, McAllister, and Yudofsky, in 2005 ............................................................ 12
Table 2: Glasgow Outcome Scale at Discharge .......................................................... 16
Table 3: Distribution of respondents by their age and gender of TBI patients ............ 30
Table 4: Distribution of respondents by their vital signs at admission of TBI patients (N=319) .................................................................................. 33
Table 5: Distribution of respondents by focused neurological signs at admission of patients (N=319) ........................................................................... 34
Table 6: Bivariate analysis of factors at patients admission associated with death outcome (N=319) .................................................................................. 36
Table 7: The results of logistic regression analysis for factors at admission associated with death outcome (N=319) ............................................................... 38
Table 8: Factors at patient admission associated with severe disability outcome (N=319) ................................................................................. 39
Table 9: The results of logistic regression analysis for factors at admission associated with severe disability (N=315) ................................................................................. 40
Table 10: The results of bivariate analysis of factors at admission of moderate disability .... 41
Table 11: The results of logistic regression analysis of factors of moderate disability (N=319) .................................................................................. 42
Table 12: Factors at admission associated with good recovery outcome (N=319) .............. 42
LIST OF FIGURES

Figure 1: Conceptual framework of factors and outcomes of patient with TBI .................. 21
Figure 2: Distribution of referring system of TBI patients ........................................... 31
Figure 3: Distribution of causes of TBI ......................................................................... 31
Figure 4: Distribution of emergency signs among patients admitted with TBI .............. 32
Figure 5: The profile of patients at discharge ................................................................. 35
CHAPTER 1: INTRODUCTION

This chapter describes and explains in detail the situations of traumatic brain injury in different areas of the world and then after it discusses different reasons this dissertation have been conducted, as well as the significance of this study.

1.1. Background

Traumatic Brain Injury (TBI) is one of the major cause of mortality and disabilities worldwide. Different studies have investigated on epidemiological features, factors influencing patient’s outcomes such as severity, the location, and mechanism of injury. It brings burden to the community range from severe disabilities imposing long term costly rehabilitation, reduced productivity and sometimes permanent to high rate mortality.

In the United States among 30 million injury-related cases visiting emergency department (ED) every year, TBI account for 16% as a primary or secondary diagnosis and one-third of related injury deaths, were attributed to TBI as a direct underlying cause of death in 2010, but the data on TBI-related disability incidence are limited (Frieden, et al., 2015, p. 19).

Epidemiological studies conducted in European countries from 1990 to 2014 have shown an overall incidence rate of 262/100,000 of admitted patients with two most frequent causes which are; fall from height (FFH) and road traffic accident (RTA) therefore falls have been reported more frequently than RTA but severe TBI has been reported to be associated with RTA than falls (Peeters et al., 2015, p. 1683). A systematic literature review involving sixty-six studies describing age and sex distribution, incidence, mechanism of injury, severity of injury, mortality, and time trends in Europe have reported the incidence rate from 47.3 to 849/100,000 population, the mortality rates ranging from 3.3 to 28.10/100,000 population per year and the most common mechanisms of injury were RTI and FFH (Brazinova et al., 2015, p. 20). Furthermore, a comparative study on TBI between the Pacific people and New Zealand have reported the incidence rate of 1242/100,000 in Pacific per year compared to 842/100,000 for New Zealand (Lagolago et al., 2015, p. 29).

Kinyanjui complained that Kenya account for continually increasing prevalence of TBI (Kinyanjui, 2016, p. 5)
A retrospective collection combined with prospective management and follow-up of 791 cases of TBI admitted to the neurosurgery department of a tertiary care hospital in New Delhi, one year study has shown that 56% of injury were caused by falls followed by 36% related to RTI and among 61% who reached the hospital within 6 hours after the event, 27% of them were unconscious (Shekhar et al., 2015, p. 132).

A Study by Puvanachandra and Hyder, (2009, p. 27), showed that 60% of cases resulted from TBI, followed by 20-30%, from falls and 10% caused by violence. The same Author confirmed that Asia accounted for having the highest prevalence of TBI-related outcomes compared to all other global regions.

In Tanzania, an analysis of a prospective observational TBI Acute Care Registry at the Kilimanjaro Christian Medical Center (KCMC), Casualty Department, revealed that the TBI cases were related to Road Traffic Crash (74%), assaults (13%), falls (8%), 52% of RTI’s involved motorcyclists with 19% of patients developed severe TBI, (Kiwango et al., 2013, p. 6). The same study reported an overall mortality rate of 13% for all patient, 14% for all admitted patients and 80% for patients specifically admitted to the ICU. Also, a mortality rate of 53%, were associated with severe TBI, while 12% and 3% fatality rates reported resulting from moderate and mild TBI respectively (Kiwango et al., 2013, p. 6).

The study by Lynch, (2013, pp. 15–22), on the epidemiology of TBI and predictors of worse outcome conducted at Kilimanjaro Christian Medical Center (KCMC), have reported the mortality rate of 13% for all admitted patients and 73% for patients admitted to ICU. The mortality was reported to be associated with severe TBI with initial Glasgow coma scale (GCS) < 9 and alcohol involvement was reported in 28% of all TBI patients.

In Nigeria, a prospective and descriptive study (Mathias et al., 2014, pp. 52) revealed that 73.4% were involved in road traffic accident, 99 have been classified as mild, 43 moderate, and 35 severe head injuries. The functional outcomes for participants were good in 89.3% and the mortality was 10.1% and the poor outcome was related mostly to low Glasgow Coma Scores at admission.

A retrospective study conducted in Uganda on distribution and characteristics of TBI at Mulago Hospital published a 25.8% of TBI-related death in the hospital (Tran et al., 2015, pp. 270–272). In the same study, it was reported that RTI especially motorcycle accidents are the most leading cause of injury and the strongest predictors of negative outcome were initial
GCS, change in GCS score during the hospital stay and the presence of hematoma in the brain.

Some contributing factors have been investigated and tested to predict poor outcome in patients suffering from TBI. Lynch, (2013, pp. 23–26) declared that a Glasgow Coma scale below 9, hypotension, hypoxia and delay to access qualified health facility contribute significantly to death and disabilities while Saini et al., (2012, p. 5) also added mode of injury (Road traffic accident), increasing age of patients, hypoxia, low GCS, abnormal pupillary reflex, greater degree of midline shift and effacement of Basal cisterns. Both authors argued that the early operative intervention when indicated may contribute significantly to the favorable outcome. Additionally, Marei et al., (2015, p. 21) found that road traffic injury as a mode of injury, age, hypoxia, anemia and presence of mass and diffuse lesions on CT scan are the significant predictors of mortality and the presence of an operable mass lesion is associated with less mortality.

Traumatic brain injury is the burden of the community word wide. It results into high mortality rate and long term disability. Factors at admission that contribute to poor outcomes have been investigated and shown significant impact but the studies were limited to factors of poor outcome and were conducted in context differ from Rwanda. So to minimize this burden to the community, the prevention efforts, clinical researchers efforts, and medical attention on patients experiencing TBI, may be a focus to identify patients at risks and provide timely and quality care.

1.2. Problem statement

TBIs are increasing day to day. Road traffic injury, fall from height and other assaults even intentional or unintentional, as well as alcohol involvement, have been reported by different studies as the causes of TBI. The severity of TBI ranges from mild, moderate to severe injury that is most serious and leading to more death and long-term disabilities.

As shown by Peeters et al., (2015, p. 1683), Traumatic brain injury (TBI) is a dangerous public health and socioeconomic burden worldwide. It results in high mortality and morbidity rates such as vegetative status and severe disability imposing long-term rehabilitation, and psychosocial consequences to the concerned family.
Kigali University Teaching Hospital, is a referral hospital with the neurosurgical center, currently receiving a high number of TBI patients whether brought by pre-hospital service/SAMU or referred from other Healthcare settings such as district hospital requesting advanced management. Indeed, on the triage and admission, the nurse is the first care provider responsible for receiving a patient, prioritize and initiate care even before medical availability to patients and the guideline used at this hospital preserve that the medical doctor may attend the patient on call by a nurse. Based on clinical experience, there are gaps in the early assessment of patient experiencing TBI where the specific neurological signs and symptoms alerting the nurse on severity of injury such as GCS and pupil reflexes were not recorded at the time so that the identification of those specific signs requires the attendance of neurologist to examine patient and this delays the diagnostic process and the initiation of required treatment, exacerbating clinical condition of patient and may lead to poor outcome and the guidelines used at triage and admission are more general than incorporating TBI specificities. In addition, the available studies on TBI were conducted in context differ from Kigali University Teaching Hospital and assuming that knowing and recognizing critical variables that are associated with poor patient outcome in triaging and admitting patient with TBI will help Nurse to identify patient at high risk of poor outcome and prioritize essentially early care and advocate for specific, particular and focused intervention to minimize the risk and promote a positive outcome.

According to Nnadi and Bankole, (2014, p. 51), epidemiological monitoring and measurement of outcome are essential in determining the extent of injuries, the quality of care, and other factors that may affect the quality of lives in patients with TBI, and ignoring the impact of critical variables at triage and admission of TBI patient may lead to a delayed diagnosis and management thus, contribute to poor patients’ outcome, (Lynch, 2013, pp. 15–27).

Therefore, this research study “factors influencing the outcome of adult patients with TBI admitted to Kigali University Teaching Hospital is required to inform clinicians to which patients are at greatest risk of poor outcome, so that they should be targeted for a particular management strategy or therapeutic intervention and promote the positive outcome.
1.3. The aims of study
This research study aims to identify the factors that contribute to the outcomes in adult patients with traumatic Brain Injury (TBI) at Kigali University Teaching Hospital.

1.4. Objectives of the study

✓ To describe the profiles of patients admitted to Kigali University Teaching Hospital for TBI
✓ To identify the factors associated with the outcomes of patients who have been admitted to Kigali University Teaching Hospital for TBI

1.5. Research questions

The following questions will help researcher to attain the aim and effectively achieve the objectives of this study

✓ What are the admission profiles of patients who have been admitted to Kigali University Teaching Hospital for TBI?
✓ What are the outcomes of TBI patients recorded at hospital discharge?
✓ There are any significant associations between patients’ profile at admission and outcomes of patients at the discharge of patients who have been admitted to Kigali University Teaching Hospital for TBI?

1.6. Significance of the study

The results generated by this research are thought to raise the awareness of nurses to the critical variables at the admission that serves as predictors of patient outcome after TBI so that they will be able to identify and recognize patient at greater risk of poor prognosis, prioritize care to minimize those risks and promote a positive outcome.

It may serve as a resource for further researchers that will help nursing management of patient experiencing TBI in order to reduce its burden to patients and families and may also serve as an academic resource and clinical training.
It also serves as the evidence practice and motivates decision makers in the development of a specific protocol to guide early Nursing care for a patient with TBI targeting to minimize the risk of poor outcome.

1.7. Operational term definitions
In this study the Traumatic brain injury means any damage or injury to the head caused by mechanical object, or any other physical mechanism involving head trauma or transferring forces to brain resulting into structural damage, impairment in brain functioning that may be a loss of consciousness/reduced level of consciousness, neurological deficit and abnormal in coordination of other system as nervous system’s concerns.

The Factor in this study is any variable, patient status or action aside from the cause of injury that may play a role in the development of a certain health status after TBI event.

The Outcome is any health status resulting from interactions of complex pathophysiological processes after experiencing a specific disease or injury and actions taken during the process of care.

TBI outcome is a status or the functional ability of the patient after the management of an injury to the brain as measured by Glasgow Outcome Scale (GOS).

1.8. The organization of this dissertation
This study contains five chapters;

The first chapter discusses the situation of TBI in different areas, it states the problem to be investigated and describes the objectives to be covered as well as the importance of the study.

The second chapter discusses the theoretical concepts around TBI, it revises the previous studies conducted on factors influencing the outcomes of patients with TBI and explains the gaps identified in previous studies and provide the conceptual framework guiding this study.

The third chapter explains in details the study design, methods, and strategies used in sampling, data collection, and data analysis.

The fourth chapter describes and interprets the results of the current study while the fifth chapter discusses the findings in relation to the other studies, provide the conclusion and recommendations of this study.
In summary, TBI is a public health problem and clinical challenges that require the recognitions of the impact of critical variables recorded at triage and admission of patients suffering from TBI. However, the conducted in context away from Kigali University Teaching Hospital as well as Rwandan context so that this study was conducted to identify the factors influencing the outcome of patients with TBI admitted at Kigali University Teaching Hospital.
CHAPTER 2: LITERATURE REVIEW

2.1. Introduction
This chapter describes and summarizes the theoretical components surrounding traumatic brain injury concept and critically discusses findings from previous studies on the topic as well as a conceptual framework guiding this study. The literature was selected through Medscape, PubMed, Elsevier, and Open access databases using TBI, factors, outcomes, and clinical management key words.

2.2. Theoretical literature around Traumatic Brain injury
Different authors describe and discuss TBI as a damage to the brain caused by external forces or object using different perspectives. There is an association of different components involved in TBI to explain it in simple and understandable concept.

2.1.1. Causes and mechanisms of injury
Trauma to the brain may be caused by blunt or penetrating object and the most event are Road traffic crash, fall from height, other insults such as gunshot, beat from conflicts that may involve uncontrolled acceleration, deceleration, acceleration-deceleration or rotational movements of the head transferring forces to the brain or direct damage resulting from either contusion, laceration, hemorrhage or a combination of all. The injury may involve an isolated area of the brain (focal) or diffuse from one area to the others or involve all part of the brain and may also cause brain edema and increased Intracranial Pressure (ICP) and disturbed brain functioning.

2.1.2. Pathophysiology

Primary brain injury is described as a damage to the brain tissue (parenchyma and vessels) that occurs at the time of the incident. It resulted from direct impact, rapid linear acceleration/deceleration or rotation movement and penetrating object directly to the brain.
The transfer of external mechanical forces to intracranial vault result into brain damages including a combination of focal contusion, hematoma, concussion and cut of white matter tracts resulting into diffuse axonal injury (DAI) with cerebral edema and swelling. The prolonged compression caused by brain edema and hematomas may lead to elevated intracranial pressure (ICP), decreasing cerebral blood flow (CBF) therefore interfere brain functioning and may sometimes cause brain tissues to herniate. Hematoma results from rupture of the cerebral blood vessels and extravasation of blood following TBI and based on their location, a hematoma may range from epidural, subdural, subarachnoid, intraparenchymal hematomas and finally to intraventricular hemorrhage. Epidural hematoma (EDH) involve the tearing of dural vessels and the blood escapes between the cranial vault and the dura matter and most of the times are associated with a skull fracture. Subdural hematoma (SDH) involves veins draining blood from cerebral cortex surfaces to dural venous sinuses so that the blood is trapped between the dura and the subarachnoid membrane and more often is associated with a superficial cerebral contusion and/or compression of adjacent brain tissue and in severe cases may cause midline shift. Subarachnoid Hemorrhage (SAH) commonly occur when small pial vessels are damaged or when there is an extension from intraventricular and superficial intra-parenchymal hemorrhage to subarachnoid space. The intraventricular hemorrhage may be caused by tearing sub-ependymal vessels or an extension from adjacent intraparenchymal or back from subarachnoid hemorrhage. Jonathan and colleagues explained a surface Contusions and laceration as distinctive damage that may affect different parts of the brain including “the poles of the frontal lobes, the inferior aspects of the frontal lobes such as the gyri recti, the cortex above and below the operculum of the Sylvian fissures, the temporal poles and the lateral and inferior aspects of the temporal lobes and may extend into white matter, comprising a mixture of hemorrhage, swelling and necrosis”, (M.Silver, McAllister and Yudofsky, 2005, pp. 29–30). It is very clear that the extensive damage may cause hematoma and the association with laceration of the pia-arachnoid may lead to bleeding into the subdural space.
Also depending on the location, the cerebral contusion may be associated or not with the sensorimotor and neurological deficit and if the surface contusions/lacerations are associated with swelling may lead to increased ICP and the subsequent sequelae. Cerebral contusion results from multiple factors interacting together and causes anatomical and physiological microcirculatory alterations leading to brain tissue death, (Alvis-miranda, Alcala-cerra, and Moscote-salazar, 2013, p. 4).

The secondary TBI is a damage to the brain induced by cascade of molecular pathophysiological responses such as neurotransmitter glutamate-mediated ion channels resulting into a transient postsynaptic cell membrane dysfunctions causing redistribution of neurotransmitters and ions, altering the membrane potential, increased Calcium influx, electrolytes imbalances and neuronal hyperexcitability, cerebral edema, raised ICP, free radical injury to brain cells, mitochondrial dysfunction, apoptosis, ischemia and diffuse axonal injury (Greve and Zink, 2009, pp. 98–99; Alvis-miranda, Alcala-cerra and Moscote-salazar, 2013, pp. 2–7; Mustafa and Al-Shboul, 2013, p. 233; Prins et al., 2013, p. 1309)

Some factors to secondary injury may be hypotension, hypoglycemia, and hypoxia (reducing substrates of oxygen and glucose to brain tissue), fever and seizures (increasing metabolic demand), and inflammatory responses that increase cell membrane permeability and electrolytes imbalances, (Prins et al., 2013, pp. 1309–1312).

2.1.3. Classification of TBI

Different classification systems have been used to classify TBI into categories and the following criteria are commonly used; anatomical abnormality features, location, extension, multiplicity, and distribution; whether the injury and finally severity (LOC, GCS, Pupillary reactivity),

Based on Glasgow Coma Scale, as severity classification system, TBI is classified into three categories; mild, moderate and severe. Also, some other criteria may be used such as the loss of consciousness (LOC) duration and posttraumatic amnesia (PTA) but GCS is the most used clinical tools to describe the severity of TBI (Percival and Kishner, 2013, p. 2)
Severe (TBI), is defined as trauma associated brain damage with a GCS score of 3 to 8. It is considered as major challenging issue in critical care units and a leading cause of mortality and disability, especially in patients above 45 years of age, (Haddad and Arabi, 2012, p. 1)

Based on anatomical abnormality features their locations from the outside to inside, injury types include; epidural hemorrhage, subdural hemorrhage, subarachnoid hemorrhage, brain contusion and laceration, intraparenchymal hemorrhage, intraventricular hemorrhage respectively, and based on distribution the injury to the brain may be focal or/and diffuse.

Based on pathophysiological process TBI may categorize into primary or secondary injury. The primary injury refers to immediate and direct parenchymal injury occurring at the time of injury event, whereas secondary injury concerns with potential damage occurring at variable times after injury that might be prevented and the important widespread recognized causes of secondary injury, are hypoxia, hypertension, hypercarbia, hyponatremia, and seizures (Saatman et al., 2008, pp. 722–724).
Table 1: The summary of TBI classification as described by M. Silver, McAllister, and Yudofsky, in 2005

<table>
<thead>
<tr>
<th>Mechanisms of brain damage after brain injury</th>
<th>Acceleration/deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td></td>
</tr>
<tr>
<td>Surface contusions, Lacerations, and</td>
<td>Tearing of bridging veins</td>
</tr>
<tr>
<td>Associated intracerebral hematomas</td>
<td>with formation of subdural</td>
</tr>
<tr>
<td></td>
<td>Hematoma, Diffuse axonal</td>
</tr>
<tr>
<td></td>
<td>injury, tissue tears, and</td>
</tr>
<tr>
<td></td>
<td>associated intracerebral</td>
</tr>
<tr>
<td></td>
<td>hematomas, Diffuse vascular</td>
</tr>
<tr>
<td></td>
<td>injury</td>
</tr>
<tr>
<td>Focal</td>
<td></td>
</tr>
<tr>
<td>Surface contusions/lacerations,</td>
<td></td>
</tr>
<tr>
<td>Intracranial hematoma, Increased</td>
<td></td>
</tr>
<tr>
<td>intracranial pressure and associated</td>
<td></td>
</tr>
<tr>
<td>vascular changes</td>
<td></td>
</tr>
<tr>
<td>Diffuse (multifocal)</td>
<td></td>
</tr>
<tr>
<td>Diffuse axonal injury, Hypoxic-ischemic</td>
<td></td>
</tr>
<tr>
<td>damage, Vascular injury</td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
</tr>
<tr>
<td>Surface contusions/lacerations, Diffuse</td>
<td></td>
</tr>
<tr>
<td>axonal injury, Diffuse vascular injury,</td>
<td></td>
</tr>
<tr>
<td>Intracranial hematoma, Injury to cranial</td>
<td></td>
</tr>
<tr>
<td>nerves and pituitary stalk.</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
</tr>
<tr>
<td>Meningitis/abscess, Increased intracranial</td>
<td></td>
</tr>
<tr>
<td>pressure and associated vascular changes</td>
<td></td>
</tr>
</tbody>
</table>

Adopted from (M. Silver, McAllister and Yudofsky, 2005, p. 28)

Based on structure being involved, and the extent of brain injury, the imaging studies classify TBI into 7 possible injuries: epidural hematoma, subdural hematoma, traumatic axonal injury, subarachnoid hemorrhage, intravascular hemorrhage, cerebral contusion, and skull fracture including depressed skull fracture, base of crane fracture and facial bone fracture and this classification may be used in selection of patients who may benefit from a specific therapy such as surgical evacuation of a hematoma, (Zollman, 2016, pp. 4–5).

2.1.4. Clinical manifestations

The clinical manifestation following TBI are altered/reduced level of consciousness, (GCS below 15), Loss Of Consciousness (LOC) that may transient or sustained depending on severity of injury, disorientation, confusion, headache, nausea and vomiting, loss of memory,
drowsiness and neurological deficit such as change in vision, loss of balance, weakness, sensory loss, paresthesia or paralysis, (Raj, 2014, p. 2).

2.1.5. Diagnostic indicators for TBI

According to Menon et al., (2010, p. 1), Marshall et al., (2015, p. 258) a patient with TBI, is one has had a traumatically induced physiologic brain dysfunction evidenced by at least 1 or more of the following symptoms:

- Any history of loss of consciousness,
- Any history of loss of memory for events immediately before or after the accident,
- Any alteration of mental state at the time of the accident (feeling dazed, disoriented, or confused),
- Focal neurologic deficits that might or might not be transient
- Posttraumatic amnesia and
- A decrease in Glasgow coma scale and


2.1.6. TBI diagnostic procedures

The initial diagnostic procedures of patients with TBI should include comprehensive history taking and focused neurological examination, neuropsychological assessment, and imaging procedure such as Skull X-Rays; to detect a fracture of the skull base or cranial vault, Computed Axial Tomography (CT scan) to reveal the presence of blood, skull fracture, and/or structural changes in the brain, and Magnetic Resonance Imaging (MRI) to determine neurological deficits not explained by CT,(the State of Colorado, 2006, pp. 15–21).

2.1.7. Treatment modalities for TBI

The guideline suggested that “the early identification and early intervention by providers with specialty training and experience are critical in diagnosis, treatment, and management of individuals with traumatic brain injury. Brain injury treatment may also require immediate interdisciplinary evaluation and treatment and the ultimate functional outcome of individuals with TBI depends upon a complex, interacting set of pre-injury, injury, and post-injury factors”, (The State of Colorado, 2006, p. 13). This protocol recommends that the treatment programs should be specialized, based on a comprehensive data set, both functional, goal and
outcome-oriented, and should be delivered in the least restrictive setting. This guideline also recommends that the treatment team should include the established emergency medical services, triage guidelines and organized prehospital trauma systems to improve the delivery of trauma care.

The treatment modalities vary depending on the severity of the injury but severe TBI treatment is critical and should be focused.

Nancy Carney et al., (2016, pp. 8–10), in collaboration with Brain Trauma Foundation, highlights the following focused interventions:

For severe TBI patients with diffuse injury (without mass lesions), and with intracranial pressure (ICP) elevation to values >20mm Hg for more than 15min within a 1-h period, Decompressive craniectomy is recommended to reduce ICP and to minimize days in the ICU.

Mannitol 0.25 to 1 g/kg body weight is effective for control of raised ICP but arterial hypotension (systolic blood pressure <90 mm Hg) should be avoided. However, in patients with signs of transtentorial herniation or progressive neurologic deterioration not attributable to extracranial causes, mannitol should be avoided.

Use of CSF drainage to lower ICP in patients with an initial GCS <6 during the first 12 h after injury may be considered.

Hyperventilation is recommended as a temporizing measure for the reduction of elevated ICP but prolonged prophylactic hyper ventilation with PaCO2 of ≤25 mm Hg is not recommended.

High-dose barbiturate administration is recommended to control elevated ICP refractory to maximum standard medical and surgical treatment. Hemodynamic stability is essential before and during barbiturate therapy. Although propofol is recommended for the control of ICP, it is not recommended for improvement in mortality or 6-month outcomes. Caution is required as high-dose propofol can produce significant morbidity.

The use of steroids is not recommended for improving outcome or reducing ICP. Evidence used in the development of this guideline revealed that in patients with severe TBI, high-dose methylprednisolone was associated with increased mortality and is contraindicated.

Feeding patients to attain basal caloric replacement at least by the fifth day and at most by the Seventh-day post-injury is recommended to decrease mortality. To achieve this trans-gastric jejunal feeding is recommended to reduce the incidence of ventilator-associated pneumonia.
Early tracheostomy is recommended to reduce mechanical ventilation days when the overall benefit is thought to outweigh the complications associated with such a procedure. Antimicrobial-impregnated catheters may be considered to prevent catheter-related infections during external ventricular drainage.

Phenytoin is recommended to decrease the incidence of early PTS (within 7 days of injury) when the overall benefit is thought to outweigh the complications associated with such treatment. However, early PTS have not been associated with worse outcomes.

2.2.8. TBI outcomes and measuring tools

TBI results in death and impairment of neurological, and cognitive functions causing the restriction or reduction of activity leading to a lack of participation in society.

A literature review conducted by Shukla, et al, (2011, pp. 1–8) on various proposed and used outcome scales to assess patient’s outcome after TBI from 1965 to 2010, showed that the commonly used are Glasgow Outcome Scale (GOS) with or without extended scores, Disability Rating Scale (DRS), Functional Independence Measure (FIM), Community Integration Questionnaire (CIQ), and the Functional Status Examination (FSE). This study highlighted some problems associated with those outcome measures include poor operational definitions, lack of sensitivity, inability to evaluate patients who cannot report, lack of integration of morbidity and mortality categories, and limited domains of functioning assessed. It recommends that GOSE satisfies most of the criteria of good outcome scale and in combination with neuropsychological tests is a near complete instrument for assessment of outcome after TBI.
Table 2: Glasgow Outcome Scale at Discharge

<table>
<thead>
<tr>
<th>Glasgow Outcome Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5</strong> Good Recovery</td>
</tr>
<tr>
<td><strong>4</strong> Moderate Disability</td>
</tr>
<tr>
<td><strong>3</strong> Severe Disability</td>
</tr>
<tr>
<td><strong>2</strong> Persistent Vegetative State</td>
</tr>
<tr>
<td><strong>1</strong> Death</td>
</tr>
</tbody>
</table>

2.3. Empirical literature

Previous studies discussed factors predicting outcome in a wide range. Most the studies used here they explored the outcome in term of death, fatality and good recovery and others explored it using GOS providing detail range of disabilities. In term of factors, some of the studies explored them as predictors of outcomes or predictors of mortality but very few studies explored them in both orientations as factors predicting favorable or unfavorable outcomes.
Chantal in her thesis; a systematic review of methodological developments and a proposal for guidelines on Prognosis after traumatic brain injury presented to University Medical Center Rotterdam; described in detail the outcome of TBI using GOS model and summarized factors that may influence the outcome including age, severity of injury (GCS), pupillary reactivity, CT scan abnormalities and the cause of injury. She found that increase in age, low GCS, SAH, mass lesion, midline shift, basal cisterns, intraventricular blood and subarachnoid hemorrhage are associated with mortality and unfavorable outcome, (Hukkelhoven, 2005, pp 8–31).

Mwala and colleagues in their article on “Factors associated with Outcome in Patients Admitted with Traumatic Brain Injury at University Teaching Hospital, Lusaka Zambia” a quantitative, observational prospective clinical cohort study, involving 211 patients mentioned a case fatality rate of 25.6% and favorable GOS of 39.7% at discharge. The advanced age, Blood pressure below 90/60 mmHg or above 150/60 mmHg, fixed and dilated pupil and GCS below 9/15 were significantly associated with unfavorable outcome, (Mwala, Munthali, and Chikoya, 2015, pp 69–70).

Catherine and colleagues in their article named “A prospective registry evaluating the epidemiology and clinical care of traumatic brain injury patients presenting to a regional referral hospital in Moshi, Tanzania: challenges and the way forward” a quantitative, observational, descriptive and prospective study involving 893 patients, they addressed the Outcome into two groups; Mortality (death) and Morbidity as expressed by GCS and length of Hospital stay.

Results classified factors into two categories;

- Category one is predictors which include; Acute diagnostics findings (Laboratory values and Radiographic images), Time of diagnosis and Acute management (airway management, addressing hypoxemia and hypotension and Surgical management)
- Category two is confounding factors such as Patient factors including age and Sex, Injury factors including the time of injury, mechanism of injury (penetrating versus blunt) and the Severity.
The prediction of poor outcome has tested and found that the mortality is associated significantly with hypotension, hypoxemia, temperature, moderate injury, severe injury, age, and sex, (Lynch, 2013, pp 2–7).

Saini and colleagues in their study “Factors predicting outcome in patients with severe head injury; Multivariate analysis”, found that age above 40, hypoxia, low GCS, abnormal papillary reflex, conservative treatment, great degree of midline shift and effacement of basal cisterns are associated with poor outcome but early operation where indicated is associated with favorable outcome, (Saini et al., 2012, pp 46–48).

A retrospective audit conducted by Minai and associates, using GCS, focal deficit, ventilator dependence and in hospital stay to measure outcome of patients after TBI, comparing two groups at admission (severe and moderate brain injury with GCS) and found the mortality rate of 46.2% and the mean GCS of 11.69 ± 5.33 at discharge in severe TBI group but in group admitted with moderate brain injury, 87.5 % recovered fully at discharge with GCS of 15/15 (Minai et al., 2013, pp 2–3). This is showing that the severity of brain injury may predict the patient outcome after TBI.

Lynch in Thesis; “The Epidemiology and Predictors of Worse Outcome for Traumatic Brain Injury Patients at Kilimanjaro Christian Medical Center, Moshi Tanzania” found that the mortality rates were 12.6% in overall participants with 13.5% of patients admitted to Emergency Department and 72.7% of patients admitted to ICU. The factors associated with mortality were RTS score, severity, hypoxia, and Hypotension. The morbidity classification showed a good recovery at 77.4%, moderate disability at 4.5%, and severe disability of 2.8% and based on the univariate analysis of morbidity, outcome of full recovery versus any disability was significantly associated with severity of TBI based on GCS, hypoxia, hypotension, and age, (Lynch, 2013, pp 15–27).

A research on “Predictors of first week mortality in severe traumatic brain injury patients” revealed a mortality rate of 63.4% and factors such as age, hypoxia, anemia, presence of and diffuse lesions on CT scan showed significant association as predictors, (Marei et al., 2015, pp 23–27).
2.4. Critical review and research gap identification
The consulted resource in this project have different level of evidence; observational, analytical, systematic review and meta-analysis studies but no randomized experimental studies have been explored.
Topics covered vary from epidemiological features of TBI, outcomes, and profiles of patients suffering from TBI, and factors predicting the outcome.
Most of the articles have internal consistency but few articles discussing factors and predictors of outcome show inconsistency where the title gives the intention on factors/predictors in general but results, discussion, and conclusion focused on poor outcomes such as mortality and case fatality or but did the factors that contribute to positive outcome were ignored.
There also issue that all available studies have been conducted in a specific context different from Rwanda but no available research findings conducted in Rwandan healthcare system on factors influencing the outcome of patients with TBI while there is an increase of admitted numbers of TBI. Therefore the current study; Factors contributing to outcome of adult patients with TBI admitted at Kigali University Teaching Hospital have been conducted to inform clinicians on admission characteristics contributing to outcome of patients with TBI in order to insight their mind on specific clinical data to be assessed on patients admission and the impact attributed to those data on patient outcome so that they may have influence on emergency care planning for TBI patients and in prediction of patient outcome.

2.5. The conceptual framework to guide this research study
The conceptual framework of this study is rooted from Healthcare quality model developed by Avedis Donabedian namely Structure-Process-Outcomes as a universally accepted and widely used model for the development and evaluation of quality standards. (Haj, Lamrini, and Rais, 2013, p. 19-21) (Donabedian, 1997, p. 1745)
Donabedian believed that the measurement of Healthcare quality should be based on three and that each component has a direct influence on the next one.
He described the structure as all the factor influencing the context by which care is delivered includes the organizational characteristics such as staff training and payment methods, equipment, and human resources, as well as patients characteristics.
The process was defined as all actions compiled together to form a package of health care that may be expanded from actions taken by healthcare provider to those taken by the patients and their families and such actions may include diagnosis, preventive care, treatment, and patient education.

The outcome in this model refers to health status indicators, as result health care on patients or populations, as well as patient satisfaction.

As this model incorporate patient’s characteristics into the components of healthcare system structure, we believe that the characteristics of TBI patients at admission may influence the quality of care delivered to patients and contribute to the patient outcome. Therefore from the described model, the conceptual framework was drawn to illustrate the connection between the patient’s characteristics recorded at admission in the emergency department for TBI, and the patient’s outcome at discharge.

All concepts are interconnected together to explain their relationship and each one is expected to contribute to the patient’s outcome.

The mechanism of injury may influence a seriousness of the injury and in turn, the severity may predict a specific outcome.

The demographic data such as patient’s age, vital signs such as Systolic Blood Pressure (SBP), Heart Rate (HR), Respiratory rate (RR), and Peripheral oxygen saturation SPO2), the severity of injury as determined by GCS, as well as pupil size and reactivity to light recorded at admission may affect the status of the patient at discharge.
Figure 1: Conceptual framework of factors and outcomes of patient with TBI
CHAPTER 3: METHODOLOGY

3.1. Introduction
This chapter discusses the approaches and procedures used to identify respondents, sampling process and data collection procedures to identify the required information as well as data analysis process as required in quantitative research.

3.2. Research Design and approach
A quantitative, retrospective and cross-sectional study were designed to describe and determine factors contributing to the outcomes of patients admitted for TBI. Because the clinical experience showed gaps in assessment and data recording and that there were no other studies conducted at this site were available, revealing what happened in the past is thought as the effective step to initiate and motivate other studies in this field.

3.3. Study setting
Kigali University Teaching Hospital (CHUK) is one of a public referral hospital in Rwanda located in Nyarugenge District, Nyarugenge sector, Province of Kigali City just in the central point of Country.
It is the National center for management of Head injury and associated cases including neurological disorders. It receives brain injury patients from other National referral Hospitals, District Hospitals and those brought by SAMU so that it admit and treat a big number of TBI patients.

It contains different services to admit and treat TBI patients at different extent including resuscitation area, Intensive Care Unit (ICU), High dependent Unit (HDU) and neurosurgical service with medical specialists (neurosurgeon and neurologist) to provide required care.

3.4. Population and sample
The concerned population of this study was the adult (16 years old and above) patients who had been admitted at Kigali University Teaching hospital for TBI from January 2015 to December 2016. The hospital record reported a total number of 1354 TBI patients received this above stated period of two years as demonstrated by emergency registries.
3.5. **Inclusion Criteria**
Operational criteria for clinical identification of TBI patients experienced the history of head trauma event with one or more of the following clinical manifestations: Confusion or disorientation, Loss of consciousness, Post-traumatic amnesia, other neurological abnormalities, such as focal neurological deficits, seizure and/or intracranial lesion including; brain contusion, brain concussion, laceration, axonal injury, and intracranial hematoma. And should be admitted for at least 24 hours either in emergency, ICU, HDU, or neurosurgery department.

3.6. **Exclusion Criteria**
Patients who have been presented for follow-up care or second visits for injury monitoring, who had been dead before the resuscitation process started, patients with associated severe chest, the abdominal or orthopedic injury, patient diagnosed to experience head/cranial trauma/injury without evidence of brain injury and child (below 16 years old) have been excluded from this study.

3.7. **Sample**

3.7.1. **Sample size**
Referred to Charan and Biswas, (2013, p. 123); Hajian-Tilaki, (2011, p. 291) and Israel, (1992, pp. 1–5), the following formula was used to calculate a number of participants; 

\[ n = \frac{Z^2(1-P)(1-P)}{d^2} \]

Where \( P \) = expected proportion of defined population, here we consider prevalence, 
\( d \) = absolute error estimated by researcher and \( Z \) = standard normal Variate observed at a precise confidence interval.

At a confidence level of 95%, \( Z = 1.96 \) and we suggest an absolute error \( d \) that does not exceed 5% or 0.05.

Considering the available prevalence of sustained head injury at CHUK (29.4%) as claimed by Twagirayezu *et al.* (2008: p 74), the sample size, 
\[ n = \frac{1.96^2 (0.29 \times 0.71)}{0.05^2} \approx 316 \text{ files}, \] so three
hundreds seventeen or above will be used to extract data on epidemiological features of TBI, patients’ outcomes and associated factors.

3.7.2. Sampling strategies
Based on TBI inclusion and exclusion criteria, a convenience sampling techniques have been used to identify required respondents. After identifying the total number of patients diagnosed with a head injury or TBI, in the registry, the index number/patient’s ID and archive codes of all participants have been listed following their respective admission dates then the files which fulfilling inclusion criteria have been selected. At the end of sampling, 319 files were identified and were all considered in data collection.

3.8. Data Collection

3.8.1. Variables
3.8.1.1. Factors Variables
At admission of the patient, the following data were considered: age, sex, cause of injury, emergency signs, vital signs such as heart rate, systolic blood pressure, respiratory rate, peripheral oxygen saturation, focused neurological signs such as Pupillary size, pupillary reactivity to the light, and the level of consciousness (GCS).

3.8.1.2. Outcome Variables
Two main outcome variables were described: mortality and morbidity. To explore Mortality, death at any time from arrival to the Accident and Emergency Department and during the hospital stay will be identified and Morbidity will be explored at the discharge of patients in term of disability at different levels.

3.8.2. Data collection instruments
To collect necessary data for the accomplishment of this study, a structured checklist was used to record data from patient files before being registered into designed SPSS database.

The checklist was created through the adaptation and compilation of variables from clinical prognostic models such as Revised Trauma Score and triaging guideline and nursing admission guideline used at Kigali University Teaching Hospital to collect the clinical data at admission and the last item of this checklist were adapted from Glasgow Outcome Scales the tool that have been developed to summarize the functional capacity of the patient rather than
listing specific disabilities and it is commonly used and validated scale to evaluate patient outcome at discharge. Therefore, the tool is composed of three sections A, B, and C;

Section A accounts for demographic information, the section B, clinical information recorded at admission of patients including the leading cause of injury, emergency signs, vital signs as well as focused neurological deficit and the last item; section C is composed by patients’ discharge status as outcome measures specific to TBI.

3.9. Validity and reliability of tools
The checklist has been adapted from methodologically validated and reliable clinical and research tools that are non-institutional tools and are acceptable for free use with minimal changes.

Different studies have validated the Revised Trauma Score as appropriate clinical tool to predict patients’ outcome after TBI so that it may be used as research tool to study the factors of traumatic brain injury outcomes, (Kondo et al., 2011, p. 1; Heydari-Khayat et al., 2014, p. 33).

A methodological research analyzing the correlation of RTS with the mortality rate in traumatic Patients indicate that the revised trauma score can be used as a tool to predict the mortality rate of traumatic patients (Heydari-Khayat et al., 2014, p. 34).

Also, the reliability of Glasgow outcome scale at discharge has been studied and it has been approved as a tool for clinical and research tool to measure disability after traumatic brain injury with high Inter-rater reliability by Glasgow University, (McMillan et al., 2013, p. 1).

And before conducting this study, a content validity was checked to assess if the tool answers the study objectives and match with conceptual framework guiding the study and it has been modified based on Kigali University Teaching Hospital working context in collaboration with experienced clinical nurses working in the neurosurgical department and checked for applicability.

3.10. Data collection procedures
After finding the ethical clearance from IRB and permission from Kigali University Teaching Hospital administration, patients who had been admitted for TBI were identified using trauma registry at the ED, and the corresponding ID was used to identify patients’ files in achieving
or filing services. On triage and admission form independent data as outlined above were extracted manually using data capture form. The outcome data were also be extracted from the file and explored on discharge form to determine the outcome of the patient and recorded manually on data capture form. Then after the computer, SPSS database was created to register the data into the computerized database.

3.11. Data analysis
Data collected from patients’ files were entered manually into SPSS version 20 database by trained data personnel.

3.11.1. Descriptive Data
Data were plotted used SPSS and Excel to assess and described with frequencies and percentages and presented in tables or graphs.

3.11.2. Correlation Analysis
Pearson’s Chi-squared test and Fisher’s Exact were used to identifying the bivariate correlations/association between factors at admission and outcome at discharge and the P values of 0.05 and 0.01 respectively were considered significant.
After performing bivariate analysis, variables that were significantly associated (P<0.05 or 0.01) with the outcome in question were recruited into a logistic regression model for analyzing multifactorial association to the outcome.

3.12. Ethics considerations
Prior to conduct this study, the ethical clearance was processed and offered from IRB, University of Rwanda, College of Medicine and Health Sciences as well as from Kigali University Teaching Hospital’s IRB. To keep confidentiality of information, checklist and the registration of data in the database were anonymous and the database is protected by password to avoid any access from other persons and the used paper are stored in a safe environment. In addition, the purpose and objectives of the study were communicated to concerned unit managers and other clinicians and required papers were addressed for classification.
3.13. Data management
To maintain information confidentiality, the database is protected by private password and only principal investigator and research assistant should know the password and have access to the database.

3.14. Data Dissemination
After the dissertation being accepted and approved it will present in conferences and or submitted to a scientific journal for scientific review and publication and as recommended by IRB Kigali University Teaching Hospital the resulted, decision and recommendations will be shared with the hospital’s research center to help their service to improve where the gaps were observed.

3.15. Limitations and challenges

3.15.1. Limitations
This study is limited to Kigali University Teaching Hospital and the findings are applied to Kigali Teaching Hospital context.

The prevalence of TBI in general population that were required to the calculation of sample was not available limiting the generalization of the findings from this study because used sample size was calculated based on the prevalence of head injury at Kigali University Teaching Hospital reported in 2008.

3.15.2. Challenges
The planned sampling strategies were changed; at the beginning of sampling the intended sample was thought to be drawn using systematic random sampling where the total TBI patients identified into emergency department registry were 1354, and a sample size of 316 TBI patient giving an interval of 4. But, through the process, it was revealed that the most cases dropping on that interval were ambulatory patients reason why this sampling method was change and the researcher consider the inclusion criteria to draw a sample.

Some patients had no GOS done at the time of discharge mandate the modification of the tool to fit documented information with the GOS standard scoring system.
The study did not include the follow-up of patients after discharge which could have added more information in terms of GOS and mortalities in the community thereby highlighting valuable information on how post-TBI patient integrate into the community in the intermediate and long term follow-up. Also some variable mentioned by other study such as the mechanism of injury (blunt or penetrating), the presence of anatomical abnormalities and midline shift on CT scan image, whether the patient undergo surgical or conservative treatment, whether the patient required the admission in ICU, the time period for final interventions and initiation of treatment have not included in this study to exclude all confounding factors.

The access to data was very challenging because of three main reasons: All cases received on emergency department even traumatic and non-traumatic, admitted and ambulatory cases were recorded in the same registry. Very few clinical information available in open clinic data base used by Kigali University teaching Hospital to record and manage patients information. And some variables such as GCS and pupillary reflexes thought to recorded at triage form and nursing admission form did not appear on forms and which appeared were not assessed at admission and wait for the availability of neurologist to focus them. This may lead to delayed diagnosis and confusion whether the severity of the injury is associated with primary or secondary injury and may worsen the patient’s outcome.

Briefly, the retrospective and cross-sectional study were conducted to describe the profile of patients and to identify the factors contributing to outcomes of TBI patients. 319 adults, TBI patients admitted from 2015 to 2016 were selected based on standards inclusion criteria, the check list was to collect data. Data were plotted for frequencies and distributions, analyzed with SPSS 20 version and the correlations were tested by either Pearson Chi square or Fisher’s exact test and logistic regression analysis.
CHAPTER 4. THE PRESENTATION OF RESULTS

4.1. Introduction
This chapter describes the findings of the current research aimed at describing the profiles of TBI patients at admission and at discharge as well as identifying factors influenced the discharge outcome. A total 319 patients’ files of adult patients admitted to the emergency department, ICU, HDU and/or neurosurgical ward for TBI have were used to find the below presented results. Pearson Chi-square, Fisher exact test, and logistic regression were used to analyze data and a P value of 0.5 or less was considered significant.

The first part (4.2) which is descriptive in nature, describes the profiles of patients who had been admitted to Kigali University Teaching Hospital with TBI. It includes two main parts; the patient profile at admissions such as the demographic data, vital signs, causes of injury, the presence of emergency signs and discharge profiles as explained by GOSE.

The second part (4.3) demonstrates the identified associations between the isolated discharge outcomes and single factor as bivariate analysis and then after determines the multifactorial associations between the profiles at admission and at discharge.

4.2. Description of admission and discharge profiles of TBI patients

4.2.1. The profile of TBI patients at admission
4.2.1.1. Distribution of respondents by their demographic characteristics of TBI patients
This study showed that the highest percentage of TBI victims variate between 21 and 40 age (51.7%), followed by the range 41-60 years old (28.2%), above 60 years old (12.2%) and, lastly by a range from 15 to 20 (7.8%). Also, male dominated with 80.9% compared to 19.1% female.
Table 3: Distribution of respondents by their age and gender of TBI patients

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-20 years old</td>
<td>25</td>
<td>7.8</td>
</tr>
<tr>
<td>21-40 years old</td>
<td>165</td>
<td>51.7</td>
</tr>
<tr>
<td>41-60 years old</td>
<td>90</td>
<td>28.2</td>
</tr>
<tr>
<td>&gt;60 years old</td>
<td>39</td>
<td>12.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>319</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>258</td>
<td>80.9</td>
</tr>
<tr>
<td>Female</td>
<td>61</td>
<td>19.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>319</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

4.2.1.2. Distribution of respondents by referring systems
The highest percentage in this study were referred by district hospital (56%), followed by SAMU (19%), referral hospital (16%), other systems (9%) including private clinics and relatives, and the least is Police.
Figure 2: Distribution of respondents by referring system of TBI patients

4.2.1.3. Distribution of respondents by causes of TBI

This study revealed that the high number of admitted cases of TBI were associated with road traffic accidents (57.4%), followed by assault (25.1%), and falls (17.6%).

Figure 3: Distribution of respondents by causes of TBI
4.2.1.4. The distribution of respondents by emergency signs at admission

Most of the cases did not present the emergency signs (70.2%) but 17.2 % reported as presenting uncontrolled hemorrhage, 9.4% with low oxygen saturation, 1.6% with severe respiratory distress and less than 1% experienced cardiac arrest.

Figure 4: Distribution of respondents by emergency signs among patients admitted with TBI.

4.2.1.5. The profile of TBI patient at admission

With regards to vital signs, 39.5% of patients (n= 126) were admitted with a heart rate between 60 bpm and 80 bpm followed by a rate of 81-100 bpm, the rate below 60 bpm, the rate of 101-120 bpm, and the rate above 120 bpm respectively. 96.9% of TBI patients were admitted with a respiratory rate of 10-29 cycles/minute, 65.8% of TBI patients presented with peripheral oxygen saturation of 95%, and above and 74.3% admitted with systolic blood pressure variating between 90 and 140 mmHg. (For detail please see the table below).
Table 4: Distribution of respondents by their vital signs at admission of TBI patients (N=319)

<table>
<thead>
<tr>
<th>Heart rate in beat by minute</th>
<th>&lt; 60</th>
<th>60-80</th>
<th>81-100</th>
<th>101-120</th>
<th>&gt;120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>56</td>
<td>126</td>
<td>79</td>
<td>35</td>
<td>23</td>
</tr>
<tr>
<td>Percentage</td>
<td>17.6%</td>
<td>39.5%</td>
<td>24.8%</td>
<td>11%</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Systolic blood pressure in mmHg</th>
<th>&gt;140</th>
<th>90-140</th>
<th>76-89</th>
<th>50-75</th>
<th>&lt;50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>69</td>
<td>237</td>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Percentage</td>
<td>21.6%</td>
<td>74.3%</td>
<td>3.4%</td>
<td>0.3%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Respiratory rate in cycles by minute</th>
<th>&gt; 29</th>
<th>10-29</th>
<th>6-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>8</td>
<td>309</td>
<td>2</td>
</tr>
<tr>
<td>Percentage</td>
<td>2.5</td>
<td>96.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peripheral oxygen saturation</th>
<th>95% above</th>
<th>94-90%</th>
<th>89-85%</th>
<th>&lt; 85%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>210</td>
<td>76</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Percentage</td>
<td>65%</td>
<td>23.8%</td>
<td>4.7%</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

4.2.1.6. Focused neurological signs

The focus of neurological signs concerned in this study was Glasgow coma scale, pupil size and pupillary reactivity to light.

The Glasgow coma scale indicated that most of the patients sustained moderate TBI (43.6%), 29.8% of patients had severe TBI, and 26.6% of patients sustained mild TBI.

The majority of TBI patients (67.4%) of patients presented with normal pupil size, 16.3% experienced unilateral mydriasis, 11.6% experienced bilateral mydriasis and 4.1% presented bilateral myosis while 0.6% presented unilateral myosis.
This study revealed that among the patients involved in the sample, 80.9% admitted with normal reacting pupils, 7.5% presented with only one pupil reacting to light and 11.6% of patients presented with both fixed pupils/not reacting to light.

Table 5: Distribution of respondents by focused neurological signs at admission of patients (N=319)

<table>
<thead>
<tr>
<th>Focused neurological signs</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow coma scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCS of 13-14</td>
<td>85</td>
<td>26.6</td>
</tr>
<tr>
<td>GCS of 9-12</td>
<td>139</td>
<td>43.6</td>
</tr>
<tr>
<td>GCS of 6-8</td>
<td>69</td>
<td>21.6</td>
</tr>
<tr>
<td>GCS of 3-5</td>
<td>26</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>319</td>
<td>100.0</td>
</tr>
<tr>
<td>Pupil size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both normal (3-4 mm)</td>
<td>215</td>
<td>67.4</td>
</tr>
<tr>
<td>Unilateral mydriasis</td>
<td>52</td>
<td>16.3</td>
</tr>
<tr>
<td>Bilateral mydriasis</td>
<td>37</td>
<td>11.6</td>
</tr>
<tr>
<td>Unilateral myosis</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Bilateral myosis</td>
<td>13</td>
<td>4.1</td>
</tr>
<tr>
<td>Total</td>
<td>319</td>
<td>100.0</td>
</tr>
<tr>
<td>Pupillary reactivity to light</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both reacting</td>
<td>258</td>
<td>80.9</td>
</tr>
<tr>
<td>Only one reacting</td>
<td>24</td>
<td>7.5</td>
</tr>
<tr>
<td>Both not reacting/fixed</td>
<td>37</td>
<td>11.6</td>
</tr>
<tr>
<td>Total</td>
<td>319</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.2.2. The profile of patients sustained TBI at discharge.

Among the victims, 62.7% reported to be discharged with Good recovery, 19.7% have been dead in hospital, 13.8% discharged with moderate disability, 2.2% discharged with severe disability and persistent vegetative status accounted for 1.6%.
4.3. Factors at patient admission associated with discharge outcome

This study used two steps to analyze the associations between discharge outcomes and the factors at admission of TBI patient. In order to analyze each single outcome in details, every outcome was dichotomized and the results are presented into two categories; the results of bivariate association and the results of logistic regression analysis.

4.3.1. The factors at patient’s admission associated with discharge outcomes

The findings of this study show two poor outcomes from the patients admitted with TBI; death and severe disability.

A mortality rate of 19.4% were significantly associated with: age above 60 years old; \( P = 0.006 \), uncontrolled hemorrhage; \( P = .000 \), Heart Rate above 120 bpm; \( P =0.000 \), Systolic blood pressure less than 75mmHg; \( P = 0.000 \), Peripheral oxygen saturation less than 85%; \( P = 0.000 \), GCS between 3-5; \( P = 0.000 \), Bilateral mydriasis; \( P = 0.000 \), and Bilaterally fixed pupils; \( P = 0.000 \) as showed by Pearson Chi square/Fisher’s exact test.

The study shows that the increase in age is associated with the increase of deaths, the same to the heart rate. Furthermore, the decrease in heart rate, peripheral oxygen saturation, and Glasgow coma scale are associated with the increase of deaths. However, a high mortality rate is observed in Systolic blood pressure less than 75 mmHg, followed by systolic blood pressure between 76 and 89 mmHg. It also is observed in bilateral mydriasis, unilateral...
myosis and bilateral myosis respectively and finally this high mortality is observed in both fixed pupillary reactivity to light.

**Table 6: Bivariate analysis of factors at patients admission associated with death outcome (N=319)**

<table>
<thead>
<tr>
<th>Age</th>
<th>16- 20 y/o</th>
<th>21-40 y/o</th>
<th>41-60 y/o</th>
<th>&gt;60 y/o</th>
<th>χ²</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>3</td>
<td>23</td>
<td>22</td>
<td>14</td>
<td>12.52</td>
<td>3.0</td>
<td>.006*</td>
</tr>
<tr>
<td>Survived</td>
<td>22</td>
<td>142</td>
<td>68</td>
<td>25</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emergency signs</th>
<th>No emergency signs</th>
<th>Severe respiratory distress</th>
<th>Oxygen saturation less than 92%</th>
<th>cardiac arrest</th>
<th>Uncontrolled hemorrhage</th>
<th>χ²</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>21</td>
<td>1</td>
<td>12</td>
<td>0</td>
<td>28</td>
<td>49.85</td>
<td>4.0</td>
<td>.000*</td>
</tr>
<tr>
<td>Survived</td>
<td>203</td>
<td>4</td>
<td>18</td>
<td>3</td>
<td>29</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heart rate</th>
<th>Below 60 bpm</th>
<th>60-80 bpm</th>
<th>81-100 bpm</th>
<th>101-120 bpm</th>
<th>Above 120 bpm</th>
<th>χ²</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>6</td>
<td>15</td>
<td>15</td>
<td>11</td>
<td>15</td>
<td>41.29</td>
<td>4.0</td>
<td>.000*</td>
</tr>
<tr>
<td>Survived</td>
<td>50</td>
<td>111</td>
<td>64</td>
<td>24</td>
<td>8</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Systolic blood pressure</th>
<th>Above 140 mmHg</th>
<th>90-140 mmHg</th>
<th>76-89 mmHg</th>
<th>50-75 mmHg</th>
<th>Below 50 mmHg</th>
<th>χ²</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>14</td>
<td>39</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>18.61</td>
<td>4.0</td>
<td>.000*</td>
</tr>
<tr>
<td>Survived</td>
<td>55</td>
<td>198</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Peripheral oxygen saturation |
A logistic regression has been performed to ascertain the effects of age, heart rate, Systolic blood pressure, Peripheral oxygen saturation, Glasgow coma scale, Pupil size, and Pupillary reactivity to light on the likelihood that TBI patients have death outcome. The logistic regression model was statistically significant; \( \chi^2 = 100.994, P = .000 \). The model showed 44.2\% (R\(^2\)) of the variance in death outcome and correctly classified 86.5\% of death cases with age, Heart rate, Systolic blood pressure, Peripheral oxygen saturation, Glasgow coma scale and pupillary reactivity to light as significant predictors for death outcome.
Table 7: The results of logistic regression analysis for factors at admission associated with death outcome (N=319)

<table>
<thead>
<tr>
<th></th>
<th>Wald $\chi^2$</th>
<th>Regression coefficient</th>
<th>Odds ratio</th>
<th>95% C.I</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>12.942</td>
<td>-.783</td>
<td>.457</td>
<td>.298 - .700</td>
<td>.000*</td>
</tr>
<tr>
<td>Emergency signs</td>
<td>3.384</td>
<td>-.228</td>
<td>.796</td>
<td>.625 - 1.015</td>
<td>.066</td>
</tr>
<tr>
<td>Heart rate</td>
<td>9.922</td>
<td>-.478</td>
<td>.620</td>
<td>.461 - .835</td>
<td>.002*</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>4.751</td>
<td>-.734</td>
<td>.480</td>
<td>.248 - .929</td>
<td>.029*</td>
</tr>
<tr>
<td>Peripheral oxygen saturation</td>
<td>11.374</td>
<td>-.625</td>
<td>.535</td>
<td>.372 - .770</td>
<td>.001*</td>
</tr>
<tr>
<td>Glasgow coma scale</td>
<td>5.851</td>
<td>-.537</td>
<td>.585</td>
<td>.378 - .903</td>
<td>.016*</td>
</tr>
<tr>
<td>Pupil size</td>
<td>1.562</td>
<td>-.254</td>
<td>.776</td>
<td>.521 - 1.155</td>
<td>.211</td>
</tr>
<tr>
<td>Pupillary reactivity to light</td>
<td>5.424</td>
<td>-.708</td>
<td>.493</td>
<td>.272 - .894</td>
<td>.020*</td>
</tr>
</tbody>
</table>

*: a significance P. value

4.3.2. Factors at TBI patient’s admission associated with severe disability

This study showed that a disability state at discharge was associated with cardiac arrest; $P = .008$, Glasgow coma scale less than 9; $P = .006$, and bilateral mydriasis; $P = .006$. 


Table 8: Factors at patient admission associated with severe disability outcome (N=319)

<table>
<thead>
<tr>
<th></th>
<th>No emergency signs</th>
<th>Severe respiratory distress</th>
<th>Oxygen saturation less than 92%</th>
<th>Cardiac arrest</th>
<th>Uncontrolled hemorrhage</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe disability</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td>.008*</td>
</tr>
<tr>
<td>Other cases</td>
<td>222</td>
<td>5</td>
<td>30</td>
<td>2</td>
<td>53</td>
<td>13.524</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Both normal</th>
<th>Unilateral mydriasis</th>
<th>Bilateral mydriasis</th>
<th>Unilateral myosis</th>
<th>Bilateral myosis</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe disability</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td>.006*</td>
</tr>
<tr>
<td>Other cases</td>
<td>213</td>
<td>52</td>
<td>33</td>
<td>2</td>
<td>12</td>
<td>13.70</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

|                                | Glasgow coma scale |                                |                                | $\chi^2$ | df | P. value |
|--------------------------------|--------------------|--------------------------------|                                |---------|-----|---------|
| Severe disability             | 13-14              | 9-12                          | 6-8                            | 3-5     |     |         |
| Other cases                   | 85                 | 138                           | 65                             | 24      |     |         |
Unfortunately, the logistic regression analysis did not show any significant prediction for severe disability outcome.

Table 9: The results of logistic regression analysis for factors at admission associated with severe disability (N=315)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Wald</th>
<th>df</th>
<th>P. value</th>
<th>O.R</th>
<th>95% C.I Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency signs</td>
<td>-.219</td>
<td>.578</td>
<td>1</td>
<td>.447</td>
<td>.803</td>
<td>.457</td>
<td>1.413</td>
</tr>
<tr>
<td>GCS</td>
<td>-.723</td>
<td>1.467</td>
<td>1</td>
<td>.226</td>
<td>.485</td>
<td>.151</td>
<td>1.563</td>
</tr>
<tr>
<td>Pupil size</td>
<td>-.370</td>
<td>1.415</td>
<td>1</td>
<td>.234</td>
<td>.691</td>
<td>.376</td>
<td>1.271</td>
</tr>
</tbody>
</table>

4.3.4. Factors at admission associated with moderate disability

The study showed that the observed moderate disability state at discharge was associated with moderate to severe brain injury; \( P = .001 \), unilateral myosis and bilateral myosis; \( P = .000 \), and one reacting pupil; \( P = .018 \).
Table 10: The results of bivariate analysis of factors at admission of moderate disability

<table>
<thead>
<tr>
<th>Glasgow coma scale</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13-14</td>
<td>9-12</td>
<td>6-8</td>
<td>3-5</td>
<td>χ²</td>
<td>df</td>
</tr>
<tr>
<td>Moderate disability</td>
<td>3</td>
<td>20</td>
<td>18</td>
<td>3</td>
<td></td>
<td>16.453</td>
</tr>
<tr>
<td>Other cases</td>
<td>82</td>
<td>119</td>
<td>51</td>
<td>23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pupil size</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Both normal</td>
<td>Unilatera l mydriasis</td>
<td>Bilateral mydriasis</td>
<td>Unilateral myosis</td>
<td>bilatera l myosis</td>
<td>χ²</td>
</tr>
<tr>
<td>Moderate disability</td>
<td>18</td>
<td>15</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>20.022</td>
</tr>
<tr>
<td>Other cases</td>
<td>197</td>
<td>37</td>
<td>31</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pupillary reactivity to light</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Both reacting</td>
</tr>
<tr>
<td>Moderate disability</td>
<td>31</td>
</tr>
<tr>
<td>Other cases</td>
<td>227</td>
</tr>
</tbody>
</table>

The logistic regression model to predict moderate disability was statistically significant, $\chi^2 = 15.825, P= .005$. The model showed 8.8% (R²) of the variance in moderate disability outcome and correctly classified 85.7% of cases with Glasgow coma scale and Pupil size as significant predictors.
Table 11: The results of logistic regression analysis of factors of moderate disability (N=319)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Wald</th>
<th>P. value</th>
<th>Odds ratio</th>
<th>95% C.I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow coma scale</td>
<td>-.482</td>
<td>4.858</td>
<td>.028*</td>
<td>.618</td>
<td>.402-.948</td>
</tr>
<tr>
<td>Pupil size</td>
<td>-.499</td>
<td>7.615</td>
<td>.006*</td>
<td>.607</td>
<td>.426-.865</td>
</tr>
<tr>
<td>Pupillary reactivity to light</td>
<td>.580</td>
<td>3.483</td>
<td>.062</td>
<td>1.787</td>
<td>.971-3.287</td>
</tr>
</tbody>
</table>

*: a significance P. value

4.3.5. Factors at admission associated with good recovery outcome (N=319)

The observed 62.7% of good recovery outcome in this study were associated with No emergency sign presented (P = .000), peripheral oxygen saturation above 95%, mild injury (P = .000), normal heart rate (P = .000), normal pupil size (P = .000) and normal reacting pupils (P = .000).

The logistic regression model to predict moderate disability was statistically significant, $\chi^2 = 143.072$, $P = .000$. The model showed 49.3% ($R^2$) of the variance in moderate disability outcome and correctly classified 81.8% of cases and the Emergency signs, Peripheral oxygen saturation, Glasgow coma scale and Pupil size are significant predictors.

Table 12: Factors at admission associated with good recovery outcome (N=319)

<table>
<thead>
<tr>
<th></th>
<th>Specific %</th>
<th>$\chi^2$</th>
<th>B</th>
<th>O.R</th>
<th>85% C.I</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>No emergency sign</td>
<td>77.2</td>
<td>6.868</td>
<td>.302</td>
<td>1.353</td>
<td>1.079-1.695</td>
<td>.009*</td>
</tr>
<tr>
<td>SPO2 above 95%</td>
<td>70.95</td>
<td>6.947</td>
<td>.504</td>
<td>1.655</td>
<td>1.138-2.407</td>
<td>.008*</td>
</tr>
<tr>
<td>Mild injury (GCS 13-14)</td>
<td>90.59</td>
<td>7.765</td>
<td>.620</td>
<td>1.859</td>
<td>1.202-2.875</td>
<td>.005*</td>
</tr>
<tr>
<td>Normal pupil size</td>
<td>79.53</td>
<td>15.881</td>
<td>.944</td>
<td>2.570</td>
<td>1.616-4.089</td>
<td>.000*</td>
</tr>
<tr>
<td>Both reacting pupil</td>
<td>72.09</td>
<td>.486</td>
<td>.239</td>
<td>1.270</td>
<td>.648-2.490</td>
<td>.486</td>
</tr>
</tbody>
</table>

*: a significance P. value
However, the results indicated 1.6% of persistent vegetative status outcome without significant associated factors at admission of concerned patients.

In summary, this quantitative retrospective cross-sectional study conducted at Kigali University Teaching Hospital revealed that at admission 51.7% variated between 21-40 years old, 80.9% were male 57.4% of injury were caused by Road Traffic Accident, 55.8% were referred by District Hospital 70.2% presented without the presence of emergency signs, 39.5% presented normal Heart rate between 60-80 bpm, 74.3% presented normal Systolic blood pressure, 65.8% presented normal peripheral oxygen saturation of 95% and above, 67.4% had normal pupil size, 80.9% had normal reacting pupils 26.6% presented with mild TBI, 43.6% with moderate TBI and 29.8% with severe TBI.

62.7%, have been classified as good recovery at discharge, 19.7% dead in hospital, 13.8% discharge with moderate disability, 2.2% discharged with severe disability and 1.6% discharge with persistent vegetative state.

The study also revealed that age above 60 years old, heart rate above 120 bpm, peripheral oxygen saturation less 85%, systolic blood pressure less than 75mmHg, Glasgow coma scale of 3-5, and both fixed pupils were significantly associated with death outcome. Moreover, cardiac arrest, Glasgow coma scale of 6-8 and bilateral mydriasis have been shown by Pearson Chi-square/Fisher’s exact test, unfortunately, they not significant with logistic regression analysis.

The study also revealed that Glasgow coma scale of 6-8, unilateral myosis, and one reacting pupil was significantly associated with moderate disability outcome’

Finally, the study revealed that the heart rate between 6-80 bpm, peripheral oxygen saturation of 95% and above, Glasgow coma scale of 13-14, and normal pupil size were significant factors of good recovery outcome.

The study did not show any association between admission profiles and persistent vegetative state outcome.
This chapter discusses the findings from this study conducted at one selected teaching hospital on factors influencing the outcome of adults patients admitted for TBI. This research sought to describe the profiles of patients with TBI at admission as well as the discharge outcome and identify the factors contributed to the described outcome. However, the discussion is divided into three main subjects responding to study objectives.

5.1. The profile of TBI patients at admission to Kigali University Teaching Hospital

It has shown that most of the patients admitted with TBI were a group of 21-40 years old (51.7%), male contributed an overall 80.9% of admitted patients, Road Traffic Accident was 57.4% followed by assault (25.1%) and falls (17.6%).

The similar findings have been shown by previous studies done in the field of epidemiology or characteristics of TBI and factors and predictors of poor outcome.

A study conducted at Lusaka University Teaching Hospital gave the median age of 29.1 years old as the most frequent and males at 87.7% and RTAs were 56.9% followed by assault at 34.6%, (Mwala, Munthali, and Chikoya, 2015).

Shisoka, (2013) also revealed that the majority of the respondents were aged between 21-30 years 52.7%, the male was 89% compared to the 11% female, motor vehicle accident scored a rate of 42.9% followed by assault (36.3%) and falling from height at 15.4%.

(Chalya et al., (2011) also showed that males sustained TBI than female 60.8% compared to 39.2%, the same study revealed that RTAs were the common cause of injury scored at an overall of 49.2%.

In line with the results of this study, Staton et al., (2015), reported that 80% were male, most common causes injury were road traffic crashes (48.8%), and Assaults (17.7%). Moreover, Tran et al., (2015) reported that the most patients admitted with TBI were males (81.7%) and RTA was the common cause of injury (74.2%). The same to the study conducted at Kilimanjaro Christian Medical Center in Tanzania revealed that the high frequency of patients involved in TBI was male (82.6%), and 74.2% of patients were involved in RTA, (Lynch, 2013).
In this study, 26.6% presented with mild TBI, 43.6% with moderate TBI, and 29.8% with severe TBI but most of consulted studies showed different results where the mild TBI were the most frequent like in the study conducted in Zambia by (Mwala, et al., 2015), the majority of the patients held mild TBI (42.7%), moderate TBI at (24.6%) and severe TBI at 32.7%. However, Staton et al., (2015) reported 75.5% of mild, 11.7% of moderate TBI, and 12.9% severe TBI. Furthermore, Lynch, (2013) reported 71.6% of mild TBI, followed by severe (17.9%), and the moderate injury of 10.5%, and Chalya et al., (2011) reported 66.1% of mild, 20.4% of moderate and 13.5% severe TBI.

Findings show that the patients who presented normal Heart (60-80 bpm) were 39.5%, 74.3% presented normal Systolic blood pressure, 65.8% presented normal peripheral oxygen saturation of 95% and above. However, very few studies discussed vital signs at admission as the patient's profiles, the more focus was put on the impact they predict the outcomes. But a study conducted by Chalya et al., (2012), revealed that the majority of patients (81.5%) had systolic blood pressure (SBP) > 90 mmHg on admission and the remaining patients (18.5%) had SBP of 90mmHg and below and in (Lynch, 2013), the hypoxia (SPO₂ < 90%) were 10.5% and hypotension (SBP <90 mmHg) were 3.2%.

5.2. The profile of TBI patients at hospital discharge

The results of this study showed that 62.7%, have been classified as good recovery at discharge, 19.7% have been dead in hospital, 13.8% have been discharged with moderate disability, 2.2% discharged with severe disability, and 1.6% discharge with persistent vegetative state.

In the line with the study findings, Chalya et al., (2011), reported that the majority of patients (85.4%) had a good recovery and an overall mortality rate was 11.2%. furthermore, Lynch, (2013), also reported a good recovery of 77.4%, followed by death (13.5%), moderate disability (4.5%), severe disability (2.8%), and persistent vegetative status (1.6%). However, some reported different findings. Like in Shisoka, (2013), a given good recovery was only 1.1%, the mortality rate was 33%, moderate disability of 17.6%, severe disability of 19.8%, and Persistent vegetative state accounted for 28.6%. And Oliveira et al., (2012), revealed that 60% discharged with severe disability, moderate disability was 33.3%, persistent vegetative
status accounted for 4.4% and only 2.2% were reported as good recovery but deaths were not mentioned.

5.3. Factors predicting the outcome of patients admitted with TBI

This study found that age above 60 years old, heart rate above 120 bpm, peripheral oxygen saturation less than 85%, systolic blood pressure below 75 mmHg, Glasgow coma scale less than 8, and both fixed pupils were significantly associated with death. Also, it revealed that Glasgow coma scale above 9 and pupil, normal heart rate, peripheral oxygen saturation above 95%, normal pupil size and non-presence of emergency signs at admission of TBI are significantly associated with good recovery.

In this study, the mortality rate in patients with mild, moderate, and severe TBI were 5.88%, 14.39%, and 89.57% respectively and the difference was significant \(P=0.000\). Some factors in this study have been also reported by Staton et al., (2015), were the predictors of mortality were increased age, hypotension, hypoxemia, and severity of TBI (moderate and severe TBI) recorded on the admission of the patient. Chalya et al., (2012), also found that the mortality was found to be significantly associated with the extreme of age, admission Glasgow Coma Score < 9, and systolic blood pressure < 90mmHg. The same study revealed that the mortality rates in patients with mild, moderate and severe head injuries were 13.8%, 24.1%, and 62.1% respectively and the mortality rates in patients with SBP < 90mmHg were 72.4 % compared to those with SBP >90mmhg (27.6%). However In Lynch, (2013), the death was significantly associated with Low Glasgow coma scale, hypoxia, hypotension, and extreme age.

Furthermore, Tran et al., (2015), revealed that 61% of death was predicted by Glasgow coma scale of 3-5 and 7.6% were associated with Glasgow coma scale of 6-8 but the greatest Glasgow coma scale was associated with positive outcome and the difference was statistically significant.

The same in Minai et al., (2013), the mortality was associated with severe TBI and minor/mild TBI resulted in the positive outcome. However, the predictor of 1st-week mortality in severe TBI patient, showed that the mortality was significantly associated with hypoxia, papillary abnormalities and, the age but the high frequency was observed in the age group of 20-40 years old, (Marei et al., 2015).
5.4. CONCLUSION
The most Traumatic Brain injury patients at Kigali University Teaching Hospital resulted from RTA, the more exposed group were 21-40 years old and high frequency presented normal vital signs such as heart rate, systolic blood pressure, and peripheral oxygen saturation as well as normal focused neurological finding including GCS, pupil size, and pupillary reactivity.
Most of the patient sustained TBI discharged with the favorable outcome with 62.7% good recovery.
The study reported a high mortality rate (19.7%) and 89.57% were associated with severe injury.

The age above 60 years old, GCS of less than 9/15, hypotension (blood pressure less than 75 mmHg), hypoxia (peripheral oxygen saturation less than 92%), and abnormal pupillary reactivity to light were significantly associated with a risk of death but favorable outcome were associated with mild TBI and normal vital signs. The findings are consistent with findings in other similar studies specifically conducted in sub-Saharan Africa. Therefore, Nurses and other Clinicians working on emergency should recognize the impact attributed by variable recorded at triage and admission and use both clinical judgment and the evidence based practice to plan for required care and predict the outcome of a patient with TBI.

5.5. RECOMMENDATIONS
Based on findings of this study and limitations accounted during the process the following recommendations and suggestions would be addressed to;

Clinicians (Nurses and Medical Doctors) who have the ethical responsibility to provide comprehensive care to TBI patients and to improve the quality of care and patient’s outcome should:

Do a clear and complete data record into the registry and open clinic including the separation of traumatic and non-traumatic cases would improve patient follow-up, data management to facilitate clinical research and evidence based development.
Use standard disease classification system to state the patient diagnosis, for example, ICD-10 disease classification system when completing patient files, clinical registry, and open clinic database would improve the clinical communication and promote quality care.

Use the standardized and reliable prognostic models specific to TBI in classification of patients into categories, in the decision of treatment modalities and in prediction of treatment outcome. For example; the revised trauma scale to measure the injury severity, Marshal classification system to classify CT scan anatomical abnormalities and Glasgow coma scale to measure the outcome, would promote standard care and positive outcome as well as prevent unnecessary risks and reduce the burden of TBI on patient, family and health care system.

Emergency and Neurosurgery Unit managers and leaders;

Specific neuro trauma tools and guidelines should be developed and used on triage and admission of patients to incorporate focused neurological parameters such as important neurological reflexes alerting the severity of brain injury and emergency nurses may be trained to perform the focused neurological assessment of patient with TBI in order to prevent delay in care and to promote positive outcome.

Further research in the area of TBI may also be recommended;

A prospective study which integrates all clinical data and process thought to affect patient’s outcome and incorporate the late outcome to assess long term adaptation of patients after discharge may be suggested.

The impact of early initiation of nursing care on TBI patient’s outcome may also be studied to improve timely nursing care focused to TBI at an emergency.

The study on the prevalence of TBI in general population is a priority in this area to guide other studies requiring sample calculation to avoid errors and bias.
References


Heydari-Khayat, N., Sharifipoor, H., Rezaei, M. A., Mohammadinia, N. en Darban, F. (2014) “Correlation of Revised Trauma Score with Mortality Rate of Traumatic Patients within the First 24 hours of Hospitalization”, *Zahedan Journal of Research in Medical Sciences*, 16(11), pp. 23–36.


50


Shisoka, J. M. (2013) *Factors that influence outcome of traumatic brain injury patients at kenyatta national hospital: A Dissertation Submitted in Partial Fulfillment of the Requirements for the Award of Master of Science Degree in M.*


Appendix I: CERTIFICATE OF COMPLETION FOR PROTECTING HUMAN RESEARCH PARTICIPANT

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that Emmanuel TUYISINGIZE successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 12/23/2016.

Certification Number: 2259391.
APPENDIX 2. CHECKLIST

Patient ID:                                                                          Archive Code:

A. DEMOGRAPHIC DATA

1. Age

<table>
<thead>
<tr>
<th>Age</th>
<th>16-20 y/o</th>
<th>21-40 y/o</th>
<th>41-60 y/o</th>
<th>≥ 60 y/o</th>
</tr>
</thead>
</table>

2. Sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

B. INFORMATION AT ADMISSION

1. Referred system/institution

<table>
<thead>
<tr>
<th>System</th>
<th>SAMU</th>
<th>Police</th>
<th>Referral Hospital</th>
<th>District Hospital</th>
<th>Other</th>
</tr>
</thead>
</table>

2. Cause of injury

<table>
<thead>
<tr>
<th>Injury</th>
<th>Road Traffic Accident</th>
<th>Fall</th>
<th>Other assault</th>
</tr>
</thead>
</table>

3. Emergency signs

<table>
<thead>
<tr>
<th>Signs</th>
<th>No emergency signs</th>
<th>Severe respiratory distress</th>
<th>Oxygen saturation less than 92%</th>
<th>Cardiac arrest</th>
<th>Uncontrolled hemorrhage</th>
<th>Unresponsive</th>
</tr>
</thead>
</table>

4. Heart Rate

<table>
<thead>
<tr>
<th>Rate</th>
<th>Below 60 bpm</th>
<th>60-80 bpm</th>
<th>81-100 bpm</th>
<th>101-120 bpm</th>
<th>Above 120 bpm</th>
</tr>
</thead>
</table>

5. Systolic Blood Pressure

<table>
<thead>
<tr>
<th>Pressure Range</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 140 mmHg</td>
<td>☐</td>
</tr>
<tr>
<td>90-140 mmHg</td>
<td>☐</td>
</tr>
<tr>
<td>76-89 mmHg</td>
<td>☐</td>
</tr>
<tr>
<td>50-75 mmHg</td>
<td>☐</td>
</tr>
<tr>
<td>Below 50 mmHg</td>
<td>☐</td>
</tr>
</tbody>
</table>

6. Respiratory Rate

<table>
<thead>
<tr>
<th>Rate Range</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 29 cycles</td>
<td>☐</td>
</tr>
<tr>
<td>10-29 cycles/min</td>
<td>☐</td>
</tr>
<tr>
<td>6-9 cycles/min</td>
<td>☐</td>
</tr>
<tr>
<td>Below 5 cycles/min</td>
<td>☐</td>
</tr>
</tbody>
</table>

7. Peripheral Oxygen Saturation

<table>
<thead>
<tr>
<th>Saturation Level</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>95% and above</td>
<td>☐</td>
</tr>
<tr>
<td>94-90%</td>
<td>☐</td>
</tr>
<tr>
<td>89-85%</td>
<td>☐</td>
</tr>
<tr>
<td>Less than 85%</td>
<td>☐</td>
</tr>
</tbody>
</table>

8. Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Scale Value</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-14</td>
<td>☐</td>
</tr>
<tr>
<td>9-12</td>
<td>☐</td>
</tr>
<tr>
<td>6-8</td>
<td>☐</td>
</tr>
<tr>
<td>3-5</td>
<td>☐</td>
</tr>
</tbody>
</table>

9. Pupil size

<table>
<thead>
<tr>
<th>Pupil Size</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both normal (3-4 mm)</td>
<td>☐</td>
</tr>
<tr>
<td>Unilateral mydriasis</td>
<td>☐</td>
</tr>
<tr>
<td>Bilateral mydriasis</td>
<td>☐</td>
</tr>
<tr>
<td>Unilateral myosis</td>
<td>☐</td>
</tr>
<tr>
<td>Bilateral myosis</td>
<td>☐</td>
</tr>
</tbody>
</table>

10. Pupillary reactivity to light

<table>
<thead>
<tr>
<th>Reactivity</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both reacting</td>
<td>☐</td>
</tr>
<tr>
<td>Only one reacting</td>
<td>☐</td>
</tr>
<tr>
<td>Both not reacting/fixed</td>
<td>☐</td>
</tr>
</tbody>
</table>
C. INFORMATION AT DISCHARGE

Glasgow Outcome at Discharge Scale

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard</th>
<th>Current context</th>
<th>Coding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Death</strong></td>
<td>When dead any time after the admission</td>
<td>When dead any time after the admission</td>
<td>1</td>
</tr>
<tr>
<td><strong>Persistent</strong></td>
<td>This condition of unawareness with only reflex responses but with periods of spontaneous eye opening</td>
<td>GCS: &lt; 8, Absent speech, Absent motor functioning</td>
<td>2</td>
</tr>
<tr>
<td><strong>Vegetative State</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Severe Disability</strong></td>
<td>This applies to a conscious patient who is dependent for daily support from another person by reason of mental or physical disability, usually a combination of both.</td>
<td>GCS: &lt; 8, Slurred speech, Severe neurological deficit(s)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Moderate Disability</strong></td>
<td>These patients have some disability such as dysphasia, hemiparesis or epilepsy and/or deficits in memory or personality but are able to look after themselves, do shopping and travel by public transport. They may be able to work when special arrangements are made.</td>
<td>GCS: 8-12, Slurred speech, Weak extremities with/without moderate neurological deficit(s)</td>
<td>4</td>
</tr>
<tr>
<td><strong>Good Recovery</strong></td>
<td>This implies a resumption of normal life with the capacity to work even if the preinjury status has not been achieved. Some of these patients have neurological or psychological deficits</td>
<td>GCS: 13-15, Clear speech, Strong &amp; Equal extremities functioning</td>
<td>5</td>
</tr>
</tbody>
</table>
APPENDIX 3. UR/CMHS ETHICAL CLEARANCE

TUYISINGIZE Emmanuel
School of Nursing and Midwifery, CMHS, UR

Dear TUYISINGIZE Emmanuel,

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance for the study entitled “Factors Contributing To Outcomes Of Patients With Traumatic Brain Injury (TBI) At Kigali University Teaching Hospital (CHUK).”

Having reviewed your protocol and found it satisfying the ethical requirements, your study is hereby granted ethical clearance. The ethical clearance is valid for one year starting from the date it is issued and shall be renewed on request. You will be required to submit the progress report and any major changes made in the proposal during the implementation stage. In addition, at the end, the IRB shall need to be given the final report of your study.

We wish you success in this important study.

Professor Kato J. NJUNWA
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

EMAIL: researchcenter@ur.ac.rw   P.O. Box 3286, Kigali, Rwanda   WEBSITE: http://cmhs.ur.ac.rw/
APPENDIX 4. CHUK ETHICAL CLEARANCE

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Ethics Committee / Comité d’éthique

February 24th, 2017

Review Approval Notice

Dear Tuyisingize Emmanuel,

Your research project: “Factors contributing to Outcomes of patients with traumatic brain injury (TBI) at Kigali University Teaching Hospital.”

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 24/02/2017 to evaluate your protocol of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your protocol.

You are required to present the results of your study to CHUK Ethics Committee before publication.

PS: Please note that the present approval is valid for 12 months.

Yours sincerely,

John Nyirigira
The Secretary, Ethics Committee,
University Teaching Hospital of Kigali

<<University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations>>

B.P. 635 Kigali- RWANDA www.chuk.rw Tel. Fax: 00 (250) 576638 E-mail: chuk.hospital@chuk.kigali.rw
APPENDIX 5. DATA ACCESS PAPER

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Department of Clinical Research
CHUK

Details of the researcher:

Name: TUMISIMIHIZI Emmanuel
First name: Emmanuel
Occupation: Student/Researcher
Department/Institution: URF, CMH, HSI, Nursing Science
Telephone number: 0782333300
Email: atumisingyiram@gmail.com

Data Access Form

Please authorize Mr/Mrs/Dr/Prof. TUMISIMIHIZI Emmanuel,
conducting a study entitled Factors contributing to outcomes of patients with traumatic brain injury (TBI)
at Kigali Teaching Hospital.

to collect data from archives.

N.B: You are requested to present your results to Research Department after your study.

Faithfully,

Dr Byiringiro Jean Claude
Head of Division (Ag) of Clinical Education and Research