PROFILE OF NON TRAUMATIC PATIENTS WITH INDICATIONS FOR MECHANICAL VENTILATION AND THEIR TREATMENT OUTCOME IN THE EMERGENCY MEDICINE DEPARTMENT OF MUHIMBILI NATIONAL HOSPITAL

NtevonaSafinielMtera, MD

MMed (Emergency Medicine) Dissertation
Muhimbili University of Health and Allied Sciences
October, 2020

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
DEPARTMENT OF EMERGENCY MEDICINE



PROFILE OF NON TRAUMATIC PATIENTS WITH INDICATIONS FOR MECHANICAL VENTILATION AND THEIR TREATMENT OUTCOME IN THE EMERGENCY MEDICINE DEPARTMENT OF MUHIMBILI NATIONAL HOSPITAL

By

NtevonaSafinielMtera, MD

A Dissertation Submitted in (partial) Fulfilment of the Requirement for the Degree of Master of Medicine (Emergency Medicine) of

Muhimbili University of Health and Allied Sciences
October, 2020

CERTIFICATION

The undersigned certifies that he has read and hereby recommended for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled: ***Profile of non-traumatic patients with indications for mechanical ventilation and their treatment outcome in the emergency medicine department of Muhimbili National Hospital***, in partial fulfilment of the requirements for the degree of Master of Medicine (Emergency Medicine) of the Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania.

_____

Dr. Hendry Sawe

Supervisor

_____

Date

DECLARATION AND COPYRIGHT

I, **Ntevona S Mtera**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature…… Date …….

This dissertation is copyright material protected under the Berne Convention, the Copyright Act 1999 and other international and national enactments, in that behalf on intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing for research or private study, critical scholarly review or discourse with an acknowledgement, without written permission of the Directorate of Postgraduate Studies, on behalf of both the author and the Muhimbili University of Health and Allied Sciences (MUHAS).

ACKNOWLEDGMENT

I would like to thank God for good health and strength to endure and go through this entire degree program and particularly during the dissertation process.

I sincerely thank my supervisor Dr. Hendry Sawe for his tireless efforts in reviewing my work and make sense of it.

Special thanks to Dr. Michael Runyon and Prof Ellen Weber for their valuable contributions that helped clear some confusions and statistical clarification.

My heartfelt thanks to Dr. Bernard Kepha, Dr BiitaMuhanuzi, Dr Catherine Shari, Dr Irene Kulola and other faculty members for their endless mentoring throughout my career.

I extend my thanks to Martin, Nuhu and the team for their help in data collection.

I would like to appreciate greatly my classmates for their endless support and encouragement throughout my career.

My sincere gratitude to my deceased parents who took me to school. Without them I would not be in this position in my life and career. Their endless, tireless support and their trust in me has kept me going through all the challenges I've faced.

I would also like to thank my beloved son David Junior Mtera, my sister Aziel E Mtera and my friend ElimbotoSindaIsingo for their incomparable support.

Sincere acknowledgement to the study participants for agreeing to be included in the study and being ever-ready to respond to follow-up calls.

DEDICATION

To my son Junior Mtera

My sister Aziel E Mtera

My dear friend Elimboto S Isingo

TABLE OF CONTENTS

CERTIFICATION ii
DECLARATION AND COPYRIGHT iii
ACKNOWLEDGMENT iv
DEDICATION v
LIST OF TABLES viii
LIST OF FIGURES viii
LIST OF ABBREVIATIONS ix
DEFINITION OF KEY TERMS x
ABSTRACT xi
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background 1
1.2 Literature Review 4
1.3 Conceptual Framework 8
1.4 Problem Statement 10
1.5 Rationale 10
1.6 Research Question 11
1.7 Objectives 12
1.7.1 Broad objective 12
1.7.2 Specific objectives. 12
CHAPTER TWO 13
2.0 METHODOLOGY 13
2.1 Study Design 13
2.2 Study area 13
2.3 Target population 14
2.4 Accessible population 14
2.5 Study population 14
2.6 Sampling design 14
2.7 Variables 15
2.8 Sample size 15
2.9 Patient recruitment and data collection 16

2.10 Data Analysis 17
2.11 Ethical Consideration 17
CHAPTER THREE 19
3.0 STUDY RESULTS 19
CHAPTER FOUR 29
4.0 DISCUSSION 29
4.1 Study limitations 31
CHAPTER FIVE 32
5.0 CONCLUSION AND RECOMMENDATIONS 32
5.1 Conclusion 32
5.2 Recommendations 32
REFERENCES 33
APPENDICES 39
Appendix 1. Case report Form 39
Appendix 2. CONSENT FORM (English version) 43
Kiambatanisho 3. FOMU YA RIDHAA - Kiswahili 46

LIST OF TABLES

Table 1: Socio-demographic characteristics of Non-Traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital 20

Table 2: Comorbidities amongNon-Traumatic patients presenting with indications for mechanical ventilation at Muhimbili National Hospital 21

Table 3: Presenting clinical characteristics amongNon-Traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital ... 22

Table 4: Laboratory results among Non-Traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital 23

Table 5: EMD management given among Non-Traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital 24

Table 6: Outcomes of Non-Traumatic patients with indications for mechanical ventilation 25

Table 7: Distribution of duration of mechanical ventilation with demographic variable .. 26

Table 8: Association of the outcome to the mechanical ventilation status..... 27

Table 9: Factors associated with poor outcome among patients receiving mechanical ventilation at ED - MNH..... 28

LIST OF FIGURES

Figure 1: Patient recruitment flow chart..... 18

LIST OF ABBREVIATIONS

AIDS	-	Acquired Immune Deficiency Syndrome
AKI	-	Acute Kidney Injury
CKD	-	Chronic Kidney Disease
ED	-	Emergency Department
EMD	-	Emergency Medicine Department
HIV	-	Human Immunodeficiency Virus
ICU	-	Intensive Care Unit
INR	-	International Normalized Ratio
IQR	-	Interquartile range
IRB	-	Institutional Review Board
IV	-	Intravenous
LOS	-	Length of stay
MNH	-	Muhimbili National Hospital
MUHAS	-	Muhimbili University of Health and Allied Sciences
HIC	-	High income countries
LIC	-	Low Income countries
CPAP	-	Continuous Positive Airway pressure
POC	-	Point of care
VBG	-	Venous blood gas
DAMA	-	Discharge Against Medical Advice
ARDS	-	Acute Respiratory Distress Syndrome
CVA	-	Cerebral Vascular Accident
CAD	-	Coronary Arterial Disease
GCS	-	Glasgow Coma Scale
COPD	-	Chronic Obstructive Pulmonary Disease
MOI	-	Muhimbili Orthopaedic Institute

DEFINITION OF KEY TERMS

Mechanical ventilation – Is the term used for machine assisted ventilation where there is a need to support or replace spontaneous breathing in a patient whose abilities to breathe are diminished or has been lost. This includes invasive and non-invasive ventilation.

Non-invasive ventilation – includes continuous positive airway pressure through a mask in appropriately selected conscious patients.

Invasive ventilation – involves having a tube inside the trachea through the mouth (or nose) or through the skin to the trachea (tracheostomy) and attaching to mechanical ventilator.

Comorbidity – Is the existence of one or more additional diseases that the patient has already been living with at the time they present with the new condition.

Immunosuppression – is the condition where the immune system of the body is failing either completely or partially

Hypoxaemia- an abnormally low oxygen concentration in the blood.

Bradypnea– an abnormally slow respiratory rate

Tachypnoea - an abnormally fast respiratory rate.

Cardiac arrest – a cessation of cardiac activity.

Edema – abnormal fluid accumulation within body tissues.

Emergency Department – a unit within the hospital that is receiving patients in need of immediate care, without prior appointment, presenting with a variety of symptoms which may not have been previously diagnosed.

ABSTRACT

Introduction: Mechanical ventilation is a means **of providing assisted ventilation in those whose abilities to breathe are diminished or lost,and can be either invasive (intubation) or non-invasive (CPAP).**Over the past decades, in the emergency departments worldwide, there has been an increase in the number of patients presenting in critical condition and mechanical ventilation is among the most important interventions **for** these patients. In many clinical settings, patients requiring mechanical ventilation remain at ED for prolonged periods while waiting for ICU admission. ED care in limited income countries is at its infancy and hence, little is known about the profile and outcomes of patients who present to the emergency department needing mechanical ventilation.

Aim of the Study: We aimed to describe the clinical profile of patients with indications for mechanical ventilation and their outcome in the Emergency Medicine Department of Muhimbili National Hospital.

Methods: This was a prospective, descriptive cohort study of consecutive adult patients presenting to Muhimbili National Hospital Emergency Medicine Department resuscitation areas (high acuity) and meeting criteria for mechanical ventilation. Data **was**collected over a period of five months from August 2018 to December 2018 at the Emergency Department and followed through their hospital stay. Patient demographic data, clinical presentation, laboratory results and ED management provided were recorded using a standardized data collection form. The overall mortality, length of ED stay and length of hospital stay was calculated and risk factors for poor outcome were determined.

Results: Of 4120 patients triaged to the resuscitation area, there were 107 (100%) patients with indications for mechanical ventilation. After excluding **14(13.1%)** trauma patients, **93(86.9%)** patients were enrolled. The median age was 53 years (IQR 36-73 years), and 47 (50.5%) were females. Among the 93 patients with an indication for mechanical ventilation 48(51.6%) received either non-invasive (CPAP) 23(47.9%) or invasive 25 (52.1%). All intubated patients were admitted to ICU, 12(25%) of those who received non-invasive ventilation were admitted to ICU, 6(12.5%) were admitted to cardiac ward, 3(6.25%) admitted to nephrology ward and 2(4.2%) admitted to the medical ward. Of the entire study sample, 28 (30.1%) patients died; 17(37.2%) were among the 45 patients who

receivedno mechanical ventilation and 11(22.9%) of the 48 who received either invasive or non-invasive ventilation.However, there was no significant difference in mortality between patients who received any form of mechanical ventilation vs. those who did not receivemechanical ventilation**, *(p=0.125).***A prolonged ED LOS (>4hrs)occurred in31(64.6%)of patients receiving mechanical ventilation and 25(55.6%) among those who did not receive mechanical ventilation. A GCS ≤8, (RR=2.914, *p*=0.038), being intubated (RR=8.462, *p*=0.034) and abnormal potassium levels (RR=4.036, *p*=0.005) were predictors of higher mortality.

Conclusion: Among patients with indications for mechanical ventilation, there was no survival benefit for those who received mechanical ventilation, although patients receiving non-invasive ventilation were significantly more likely to survive than those who were intubated. This difference may be because the ED is more likely to intubate the sickest patients, who have a higher risk of death. Low GCS≤8 and abnormal potassium levels were also independent predictors of mortality.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Over the past decades, in the Emergency Departments worldwide, there has been an increase in the number of patients presenting in critical condition. In the United States visits have increased from 42million per year in 1960 to over 92million in 1990 (1). Currently Emergency Departments in the US have an average of 100million annual visits accounting for 40% of total hospital admissions (1). 25% of those are in critical condition (2). EDs do a great deal of critical care, at least in HIC, and mechanical ventilation is an important part of that. Annually, approximately 250,000 patients receive mechanical ventilation in US – ED and more than 20% have adverse outcome (3).

Taking care of critically ill patients is highly resource intensive and consumes a lot of time among patients who present to an ED and critically ill ventilated patients require a high level of care and are at high risk of adverse events (4).

Emergency department is often the primary entrance of patient to the hospital. It deals with early resuscitation and stabilization of patients with different disease condition (5)**.** Management of these patients may require mechanical ventilation for various reasons(6)**.**

There are few studies done on patients with indications for mechanical ventilation and their outcome after receiving mechanical ventilation at Emergency Department. Most of these are done on specific conditions or diseases and other studies have been done on ICU patients (3)(7).

Astudy done by Angoti et al. showed that, the longer time spent by patient in ED after intubation while waiting an ICU admission **was associated** with poor outcome of these patients. Of 525 patients enrolled, 461 were ventilated for less than 7 hours in the ED and 64 were ventilated more than 7hours in the ED. Increased mortality was seen among those ventilated in the ED for more than 7hours. The hazard ratio (HR) for mortality for >7 hours of mechanical ventilation in the ED was 1.31 (95% confidence intervals [CI] [1.03-1.70], $P < 0.001$), and the HR remained significant for all time points greater than seven hours(8)**.**

In low income countries, there is **minimal** information on critically ill patients, and particularly about ventilation because of the disparity in quality of care and resources within developing countries (9)**.**

Studies on patients with indications for mechanical ventilation at ED are very few, however, among these few studies, it is clear that the need for mechanical ventilation is frequent (9)(10)**.**

The study done by**Ampofo et al** looking at respiratory failure requiring mechanical ventilation in critically ill adults at ED and ICU in Ghana showed that 1111 patients were triaged as critically ill over a period of 6months. 102 (8.8%) were intubated and received mechanical ventilation (9).

We do not have very good literature on the outcomes of patients intubated in the ED. But we do know that it can prolong the stay in the ED while waiting for anICU bed(2). In addition, patientsreceiving mechanical ventilation are at risk for ventilator associated complications, for example ventilator associated pneumonia, barotrauma and subsequent acute respiratory distresssyndrome(6)(8)(11)(12)(13)**.**

Patients on ventilators require a high level of care and are at high risk of adverse events (14). Globally there are few studies that have been done on the outcome of patients whose mechanical ventilation is initiated at ED (7)**.** Studies show that patients requiring mechanical ventilation remain at ED for prolonged periods while waiting **for** ICU admission (4)(15)(16)(17)and long waits can result in a poorer outcome. A study done by Hung et al conducted at Kaohsiung Chang Gung Memorial Hospital, a medical centre in southern Taiwanshowed that non-traumatic, medically illpatients who were mechanically ventilated at ED for more than 4 hrs were more likely to havean adverse outcome (4). Critical care personnel are well trained in caring for critically ill patients and more familiar with ventilators than most ED staff (17). ED staff are overwhelmed by incoming patients (1)(18). This may affect caring and monitoring patients on ventilators.

In Africa, EmergencyMedicine is a new emerging specialty (19)It is not known exactly what the burden of critically ill patients was previously before the initiation of emergency departments and acute care services because of poor documentation (20). However, it is

expected that the new EDs in our setting will be able to handle critical, medically ill patients, and mechanical ventilation is an important facet in caring for these patients**.** (21)Given the lack of intensive care specialists, ICU beds, ventilators and trained staff in these settings, as well other factors associated with low resource settings, we need to investigate the outcome of these patients.

So, it is important to know which patients have indications for ventilation, how many receive mechanical ventilation, what their ED length of stay is and their outcome.

Knowing the outcome of patients with indications for mechanical ventilation at Emergency Department before being admitted to ICU will indicate if there is a need for improving mechanical ventilations services.

In Tanzania the specialty of Emergency Medicine started in 2010 at Muhimbili National Hospital (MNH)(22), following the launch of full capacity emergency medicine department (EMD), which was then followed by the launch of the residency training program at Muhimbili University of Health and Allied Sciences (22)**.** The EMD at MNH is supposed to have two working ventilator machines that are used to support patients who need invasive and non-invasive mechanical ventilation; however, this is variable and most of the time there is only one. To the best of the authors' knowledge, there is no published data describing demographic and clinical characteristics, management and outcome of patients with indications for mechanical ventilation in ED's in our setting. This study will offer an opportunity to document the current practice and the outcome for patients with indications for, and those receiving, mechanical ventilation. Evaluation of the results will allow us to determine gaps in care, and facilitate the implementation of evidence-based care protocol for mechanical ventilation.

1.2 Literature Review

Mechanical ventilation is a means of providing assisted ventilation for patients in those whose abilities to breathe are diminished or lost. Gas exchange capability is lost in the course of a disease process or in patients who cannot protect the airway due to reduction in level of consciousness and impairment in the function of muscles of respiration, which can be caused by varieties of disease/medical conditions e.g. damage to the brain respiratory centres in stroke or multiple sclerosis (6),(8).

Mechanical ventilation systems come in a variety of forms, though all systems use a machine called a ventilator that pushes air into the patient's lungs through the trachea, bronchi and the lungs (6),(21),(23).

Mechanical ventilation can be invasive or non-invasive. Invasive type of ventilation is the delivery of ventilation through an oral-tracheal tube or tracheostomy. Non-invasive mechanical ventilation is the delivery of positive pressure ventilation via a tight-fitting mask that covers the nose or both the nose and mouth in spontaneous breathing patient (24)(25).

Mechanical ventilation originated about five centuries ago and has been saving lives of people. It has catalysed the development of modern ICU's (26) and now the development of modern Emergency department. While mechanical ventilation done at ED is thought to be a life-saving technique, studies have found it has significant implications in the outcome. Sanchez et al found that mortality after ED intubation is high(27).Another study by Page et al found that ED hyperoxia was associated with increased mortality in patients receiving mechanical ventilation at ED (28).

Initial management of adult patients presenting to an Emergency Medicine Department (EMD) involves measurements of their vital signs and provider evaluation (29)(30). Vital signs are clinically measured markers of critical physical-chemical and metabolic functions of the body and include the heart rate (HR), respiratory rate (RR), blood pressure (BP), temperature (T) and peripheral capillary oxygen saturation (SPO2) (29)(30). Vital signs provide critical information about the progress of disease and recovery (30). The normal ranges for a person's vital signs vary with age, weight, gender, and overall health.

Vital signs can also be used to identify patients with indications for mechanical ventilation (30)(31)**.**

1.2.1 Frequency of mechanical ventilation in EDs

In the USA, approximately 250,000 ED patients receive mechanical ventilation annually. (32).

A prospective observational study conducted in four Metropolitan Emergency Departments in Toronto Canada, published by *Rose et al* found that mechanical ventilation in**non-traumatic** patientsoccurred in 0.5% (95% CI 0.4% - 0.5%) of all ED visits (16).

A retrospective study by***Green et al***on all patients presenting to the Queen Elizabeth II Health Science Centre in Halifax, Nova Scotia, assessed the length of stay and invasive procedures performed on critically ill patients. It was a retrospective medical record review of all patients presented to the study Centre over one year and **excluded of trauma patients seen by multidisciplinary trauma team**The results revealed that70% of the patients admitted to ICU (125/178) required endotracheal intubation and hence mechanical ventilation, with the majority of the intubations (118/125, 94.4%) being performed in the ED (2).

In Africa in general, and Tanzania specifically, little is known as there are few studies on mechanical ventilation at ED (19)(20)(9).

A prospective observational study by***Ampofo et al***done in Ghana on respiratory failure requiring mechanical ventilation in critically ill adults, recorded the number of patients intubated and ventilated in ED and ICU and assessed for the presence of ARDS. 102 patients were intubated of which 82 were assessed by the study team and 20 patients died before they were assessed. Two patients (2.4%) were identified with ARDS and both died(9).

1.2.2 Clinical presentations

In a prospective study done by***Jeong et al*** in 12 Korean ICUs, the initial presentations in mechanically ventilated patients were pneumonia 23%, acute respiratory failure 16%, sepsis 10%, ARDS 10%, Congestive Cardiac Failure 6%, cardiac arrest 5%, Aspiration 4%, coma 8%, acute asthma 8% and others 1% (33).

In a retrospective review done by *Easter et al*, based on a national sample of hospitals in the US, the most frequent diagnoses associated with intubation in the ED were respiratory diseases (34.5%; 95% CI, 30.8%-38.2%), cardiovascular diseases (31.4%; 95% CI, 28.0%-34.9%), and injury/poisoning (31.3%; 95% CI, 27.6%-34.9%).

A retrospective study done in a rural Indian population by***Chiwane et al*** revealed that the primary causes for mechanical ventilation was sepsis, neurological, cardiac, renal and respiratory, followed by others like envenomation, drug overdose, organophosphate poisoning, etc. Hypertension and diabetes were the commonest co-morbidities (34).

1.2.3 Duration of mechanical ventilation in the ED

Easter et alin United States EDs compared the length of ED stay for ventilated patients with non-ventilated ED patients admitted to the ICU and to all other ED visits, Median ED LOS was 197 minutes for intubated patients, compared to 224minutes for other ICU admissions and 140minutes for other ED visits (3).

It is already known that patients on mechanical ventilation are at risk for ventilator-associated complications, including ventilator-associated pneumonia, barotrauma and subsequent acute respiratory distress syndrome (11)(6)(12)(13). However,the incidence of complications increases with a longer duration of stay in the ED. In a multicentre prospective study of patients intubated and ventilated in ED conducted at 3 academic level Trauma centres, ED duration of mechanical ventilation of more than 7 hours was associated with increased mortality at 45.9% versus 29.4% (p=0.018) for those who were ventilated and remained in the ED for less than seven hours (8)**.**

1.2.5 Outcome of patients with indications for mechanical ventilation

While intubation can be a life-saving procedure, patients who are intubated have had worse outcomes than those who don't in some studies.***Easter et al*** used a nationally representative sample of all EDs in the United States to perform a retrospective review on the use and outcomes of mechanical ventilation at ED. In-hospital mortality was significantly higher for ventilated patients 24% than ICU admissions or other admissions (3).

In a study done by ***Sanchez et al*** on mortality after ED intubation which reviewed 163 intubations showed that 44(27.0%) died prior to discharge from hospital, 42(25.8%) patients were discharged to skilled nursing facility and 71(43.6%) were discharged home (27).

1.2.4 Factors associated with poor outcome

Lung protective ventilation is the practice of ventilating patients using more physiological tidal volumes, avoiding high inspiratory plateau pressures along with appropriate levels of positive end-expiratory pressure to decrease pulmonary complications and improve patients' outcome (35)**.**

In aquasi-experimental, before and after study done by *Brian et al* ata tertiary academic centre in the US, the outcomes of patients were assessed before initiation of a lung protective mechanical ventilation protocol and, in another cohort, after initiation. The results showed a decrease in primary outcome (mortality) in the intervention (lung protective) group (19.6%) compared to pre-intervention group where mortality was (34.1%) (32). So, having no protocol at ED has shown to be associated with poor outcome.

***Angoti et* al**conducted a multicentre prospective observational study at 3 academic level 1 trauma centres in the US on duration of mechanical ventilation in ED, enrolled 535patients of whom525 qualified for the study. There was lower mortality associated with duration of mechanical ventilation in the ED of less than seven hours (29.4%) as compared to those with duration of **more than** 7hours (45.9%), although there were no differences in ICU or hospital LOS. Older age and admission to the neuroscience's ICU were independently associated with higher mortality (8)**.** The study also showed that despite the long time spent by patients in ED while waiting for an ICU admission, there were few changes made to the ventilator settings, and this was associated with poor outcome of these patients.

An observational cohort study by ***Page et al***conducted in the ED and ICUs of an academic centre in the USA studied a total of 688 patients. ED normoxia occurred in 350 (50.9%) patients and 300 (43.6%) had exposure to ED hyperoxia. The hyperoxia group had a median (IQR) ED P_aO_2 of 189 mm Hg (146–249), compared to a P_aO_2 of 88 mm Hg (76–

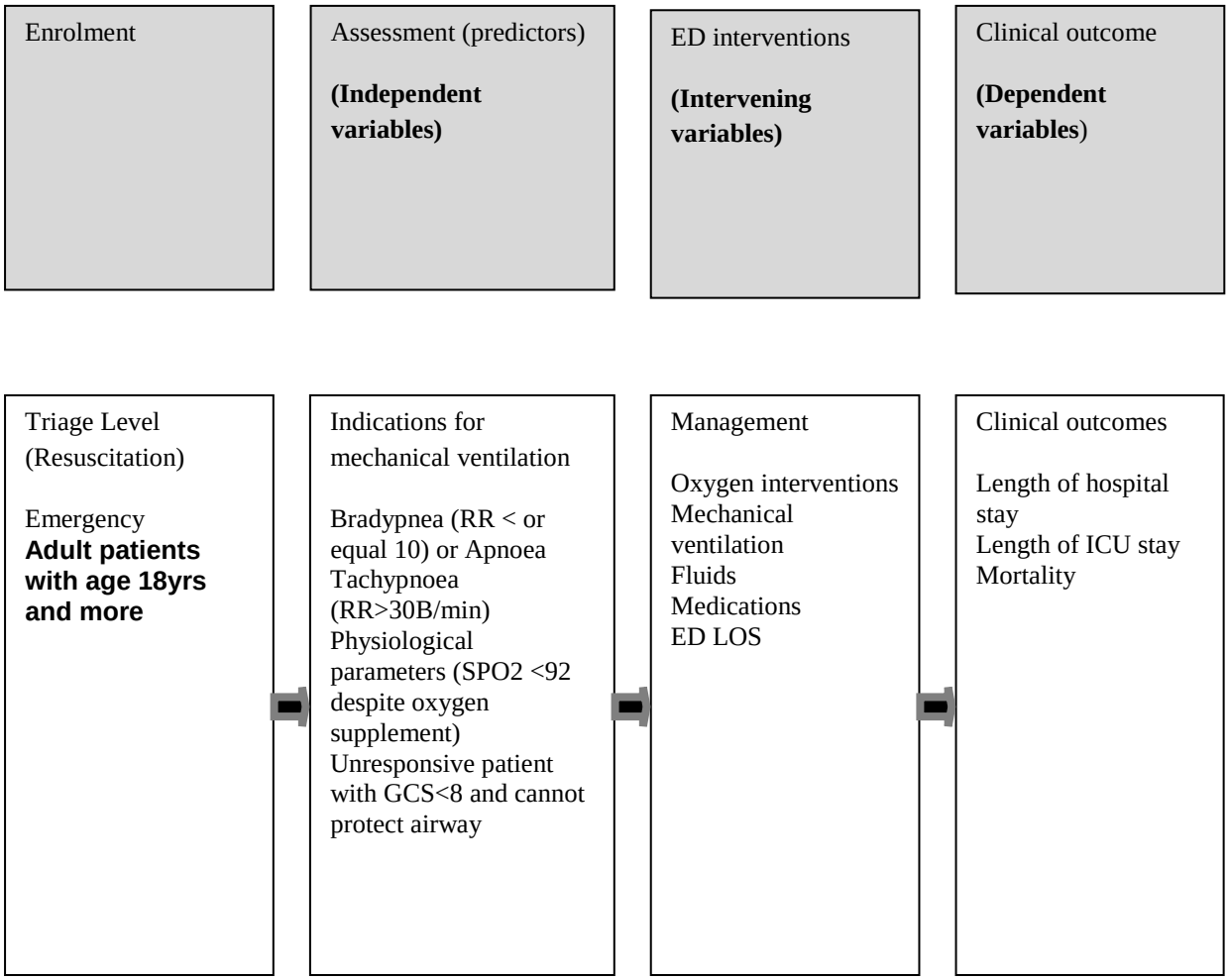
101) in the normoxia group, $P < 0.001$. Patients with ED hyperoxia had greater hospital mortality (29.7%) compared to those with normoxia (19.4%) and hypoxia (13.2%). After multivariable logistic regression analysis, ED hyperoxia was an independent predictor of hospital mortality (adjusted OR 1.95 (1.34–2.85)) (28).

Hence, they concluded that the outcome of these patients not only depends on the factors present at the start of mechanical ventilation but also on the complications and management they received.

In low income countries, there is very limited information on factors associated with poor outcome for patients ventilated at ED.

In Tanzania, there are no published studies on patients who receive mechanical ventilation in the ED. However, ***Said et al*****, published a study** on 'in patient nursing care' of ventilated patients at MNH, which revealed an association between nurse education levels and the practice of appropriate measures to prevent ventilator associated complications Furthermore, the study demonstrated an association with the outcome of patients receiving this management (36).

1.3 Conceptual Framework



Developing a conceptualframeworkfordissertation(37)

The patients on arrival at the Emergency Department of Muhimbili National Hospital are being triaged according to their severity of illness in three categories: the queue patients, priority and emergency patients who are sent to Resuscitation rooms. Adult patients triaged as emergency were assessed for the study. Patients who have indications for mechanical ventilation may or may not receive it. Their outcome may depend on not only whether they receive ventilation, but also the condition of the patient and their prognosis, specific indication for intubation (if intubated), proper management in the ED (including mechanical ventilation, pressor, oxygen, and the duration of ED stay). This study will describe the profile of the patients who have indications for mechanical ventilation, the ED care and their outcomes.

1.4 Problem Statement

In resource limited countries, as elsewhere, the number of patients who are critically ill is increasing (34). The introduction of emergency medicine provides the possibility of critical interventions **with emergency airway management being a major key for successful resuscitation of critically ill non-traumatic patients** (38). However, the management of patients requiring mechanical ventilation is highly resource intensive and time sensitive as these patients need a high level of care and they are at risk of adverse events (39). Emergency medicine departments often have a shortage of resources and personnel trained for longitudinal management of these patients. (17)(18). This may have a significant effect on the outcome of patients who spend time **in the ED** while waiting for admission in the ICU. Furthermore, **non-traumatic**patients in the emergency department in need of mechanical ventilationhave been shown to have protracted lengths of stay while awaiting ICU admission(4)**.** Prior studies suggest that long lengths of stay in the ED for intubated patients worsen outcomes.

There is a shortage of resources including ventilators to care for patients requiring mechanical ventilation.

There are no studies or reports at MNH on outcome of patients receiving mechanical ventilation in the ED and if mechanical ventilation initiated **in the ED** in our setting improves outcome.

1.5 Rationale

The goal of this study was to determine clinical presentations, management and outcome of **non-traumatic adult patients** presenting to the EMD of MNH with indications for mechanical ventilation, how many **receive mechanical ventilation** and how many **do not receive mechanical ventilation** and the outcome of patients receiving each form of management. The study focused on non-trauma patients, and excluded trauma patients because trauma patients tend to be otherwise healthy and are usually intubated for airway protection or ventilatory support (e.g. **spine injury patients)** rather than hypoxia, or acidosis. Also, **trauma patients have short duration of ED stay and thus the ED's care has much less impact on outcome.**(16)(40)(41)**.**

This study will give us an idea of how often mechanical ventilation is indicated, what is the practice for patients requiring mechanical ventilation and understanding the outcomes of patients receiving mechanical ventilation, so we can address the quality of our care.

The study results may help to determine the need for additional resources in the ED, and the need to create local departmental protocols that could help guide emergency physicians to properly manage these patients who present to the ED with indications for mechanical ventilation.

1.6 Research Question

What is the clinical profile of **non-traumatic adult patients** with indications for mechanical ventilation, their ED management and their treatment outcome in the Emergency Medicine Department of Muhimbili National Hospital?

1.7 Objectives

1.7.1 Broad objective

To describe the clinical profile and treatment outcome of **non-traumatic**patients with indication for mechanical ventilation in the EMD - MNH from **August to December 2018.**

1.7.2 Specific objectives.

1. To determine the proportion of **non-traumatic**patients with indications for mechanical ventilation that received it at the EMD-MNH from **August to December 2018.**

2. To describe the clinical presentation of **non-traumatic**patients with indications for mechanical ventilation presenting to the EMD-MNH from **August to December 2018.**

3. To determine the duration of mechanical ventilation in **non-traumatic**patients receiving mechanical ventilation at EMD – MNH from **August to December 2018.**

4. To determine factors associated with poor outcomes among those**non-traumatic patients** who underwent mechanical ventilation at the EMD-MNH from **August to December 2018**

5. To determine the mortality rates of **non-traumatic**patients with indications for mechanical ventilation according to whether or not they receive it in the ED - MNH from **August to December 2018.**

CHAPTER TWO

2.0 METHODOLOGY

2.1 Study Design

This was a**p**rospective observational study of Adult**non-traumatic** patients of 18yrs and above presenting to EMD with indications for mechanical ventilation between August to December 2018.

2.2 Study area

This study was conducted at the Emergency Medicine Department and ICU of Muhimbili National Hospital. Muhimbili National Hospital is a tertiary hospital located in Dar es salaam, Tanzania. It has a bed capacity of 1,500 with around 1,000 to 1,200 inpatients per week. Emergency medicine department is **part of MuhimbiliNational Hospital** and it is the entry point to the hospital for most of the patients(22).

The department is staffed by Interns (fresh graduates from medical school), 18 Registrars (registered medical practitioners who are 1 to 3 years post internship), 18 Emergency medicine Residents (all had already worked as registrars before joining the 3-year residency program), 8 Emergency medicine specialists and 1 super specialist. All the doctors work under supervision and training from the locally trained emergency physicians with support and consultation from a group of board-certified emergency physicians from the USA, Canada, and South Africa(22).

The department serves a high-acuity patient population from within Dar es Salaam and receives referral patients from throughout the country. Of the 36000 patients seen each year, only 20% are discharged home from the EMD. The top five categories of complaints seen in the department are trauma, infectious, mental health, neoplasm and pregnancy related issues (22).

At Muhimbili National Hospital Emergency Department, patients have an initial assessment and vital signs taken, and thenaretriaged to respective areas depending

on acuity.After evaluation, they are sent home, wards, theatre or ICU depending on their condition.

2.3 Target population

Non-traumatic adult patients of 18yrs and above presenting to acute care areas/emergency departments of tertiary referral hospitals in Tanzania with indications for mechanical ventilation.

2.4 Accessible population

All non-traumaticadult patients of 18 years and above presenting at EMD Muhimbili National Hospital with indications for mechanical ventilation

2.5 Study population

All **non-traumatic Adult patients** of 18 years and above presenting at EMD Muhimbili National Hospital with indications for mechanical ventilation at the time when the study was in progress.

2.6 Sampling design

Consecutive sampling of 24hours a day for 7days of all Adult non-traumatic patients of 18yrs and above with indication for mechanical ventilation presenting at ED – MNH were recruited for the study between August to December 2018.

Subjects

Inclusion criteria

- Patients triaged to resuscitation rooms
- Patients with indications for mechanical ventilation

Indications for mechanical ventilation: - (based on standard clinical practice(25))

- Bradypnea (RR < or equal 10) or Apnoea
- Tachypnoea (RR>30B/min)
- Physiological parameters (SPO2 <92 despite oxygen supplement)
- Unresponsive patient with GCS<8 and cannot protect airway

- **Non-traumatic**Adult patients of 18yrs and above

Exclusion criteria

- Presence of tracheostomy

- Long term mechanical ventilation
- Transfer to another hospital
- Brought in patient intubated from other hospital
- Trauma patients

2.7 Variables

- Demographics
- Presenting features
- Comorbidities
- Duration of stay

Predictor variables

- Bradypnea (RR = 10)
- Tachypnoea (RR =30 Breath/ min)
- Physiological parameter (SPO2=90%)
- GCS = 8 and cannot protect airway.
- Median ED length of stay of 4hours
- Mechanical ventilation status

Outcome variables

- Mortality
- Length of Hospital stay

2.8 Sample size

The sample size of this study was estimated from a formula below based on the mortality of 34.1%

$$\frac{N=4Z\alpha^2 P\,(1-P)}{W^2}$$

N= Estimated Sample size

P=Expected proportion which is 45.9% (0.45)

Z=standard normal deviation which is 1.96 at 95%

W=Margin of error which is p/2

Hence the estimated sample size for this study will be 61

Expected positive results in sample x =27

2.9 Patient recruitment and data collection

Consecutive sampling was used. Patients who were triaged as emergency were screened to see if they met the inclusion criteria. Standardised data collection form was used to assess the eligibility criteria of all patents presenting to the emergency department.All eligible patients or the proxy of patients enrolled in the study were asked to provide informed consent after they have received full information about the study.

Standardized data collection form

The standardized data collection form had three parts:

- **Baseline assessment of patients**

Research assistants documented prospectively the patient's baseline information (demographics, initial vital signs, chief complaints, pre referral information and final diagnoses). This information was prospectively recorded from the provider's clinical notes while the patient was in the ED.

- **Case reporting**

Information from the files of patients who met the inclusion criteria were recorded in the part II of the form. Pertinent data from the history and physical examination, comorbidities, laboratory results, treatment delivered, and emergency provider's clinical impressions and disposition were recorded in the ED. All diagnostic, treatment and disposition decisions were made at the sole discretion of the treating ED physician.

- **Case follow up**

Research assistants traced all the patients (through their clinical files), throughout the duration of the study, to record the duration of hospital stay, clinical progress (if the patient was admitted to high acuity ward), final hospital diagnoses and clinical outcome (discharge or death) were recorded in the second part of the form.

2.10 Data Analysis

Data from questionnaires were entered into Microsoft® Excel® 2013 sheet and later on transferred to Statistical Package for Social Sciences® (SPSS).

Patient descriptive characteristics, comorbidities, clinical presentations, laboratory findings and ED management were reported, using frequencies, medians and IQR. The proportion of patients with an indication for mechanical ventilation, and the proportion of these that received it, was determined**.** The length of hospital stay was calculated as a median (IQR) and in-hospital mortality by proportion with 95% confidence intervals. Risk factors for mortality were calculated using relative risk.

2.11 Ethical Consideration

This study was conducted after approval from the MUHAS IRB and permission from MNH. A verbal consent was requested from a patient or patient's proxy. Data collection was only undertaken after a patient or a patient's proxy has consented to participate in the study. The structured questionnaires were identified by serial numbers and patient's medical record number and not patient's name**.** The use of medical record number was required for tracking patient's information related to the study in case a need arises to revisit medical record of a certain patient for missing information or correctness. The completed questionnaires were not shared with anyone.

FLOW CHART

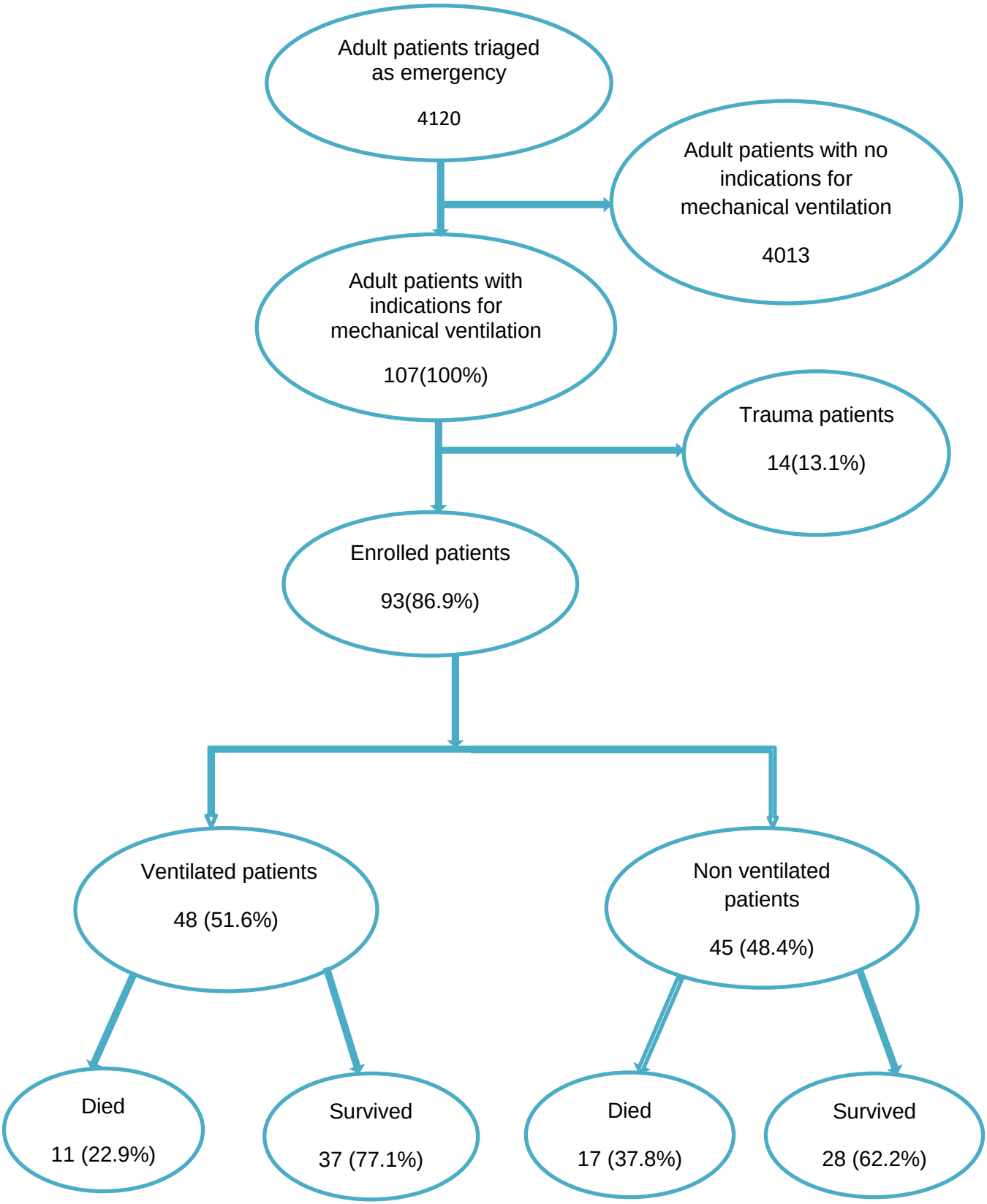


Figure 1: Patient recruitment flow chart

CHAPTER THREE

3.0 STUDY RESULTS

During the study period, 4120 adult patients were triaged to level 1 (emergency) of care. 107 (100 %) patients met the criteria for indications for mechanical ventilation. However, 14 (13.1%) were trauma patients and hence excluded. Among 93 patients enrolled in our study, 48 (51.6%) received mechanical ventilation while 45(48.4%) did not receive mechanical ventilation.

Among those with indications for mechanical ventilation, median age was 53 (IQR 36 to 73) years and 47 (50.5%) were females. 50 (53.8%) of patients were referred, 66 (71%) reported to have no health insurance coverage, comorbidities were present in 72(77.4%) of patients. **Table 1**.

Table 1: Socio-demographic characteristics of non-traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital

VARIABLE	FREQUENCY (%)
Age	
Median age (yrs.)	53 (IQR 36 to 73)
>65 years*	43 (46.2%)
<65 years	**50 (53.8%)**
Sex	
Female	**47 (50.5%)**
Male	46 (49.5%)
Referral Status	
Hospital referred	**50 (53.8%)**
Self-referral	43 (46.2%)
Insurance Status	
Cost sharing/public	**66 (71%)**
Insured	27 (29%)
Comorbidity status	
With comorbidities	**72 (77.4%)**
Without comorbidities	21 (22.6%)

* From a chronological point of view – Sieber CC et al(44)

Most of the enrolled patients had at least one comorbidity of which hypertension was commonly seen, 42 (45.2%) and the least was CVA/TIA 1 (1.1%).**Table 2**

Table 2: Comorbidities among non-traumatic patients presenting with indications for mechanical ventilation at Muhimbili National Hospital

Comorbidity	**N=93** **n (%)**
Hypertension	**42(45.2)**
Heart failure	19(20.4)
Diabetes mellitus	15(16.1)
End stage kidney disease	14(15.1)
Immunosuppression	7(7.5)
PUD	3(3.2)
Others	3(3.2)
CVA/TIA	1(1.1)
None	21(22.6)

GCS of less than 8 was observed in 18 (19.4%) of patients. Tachypnoea was observed in 40 (43%) patients. Hypoxia, (SpO2<90) was found among 58 (62.4%) patients.**Table 3**.

Table 3: Presenting clinical characteristics among non-traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital

VARIABLE **Vital signs(%)**	**FREQUENCY**
*Sp02<90%	**58 (62.4%)**
Tachycardia (HR>100 /min)	57 (61.3%)
*Tachypnoea ≥30	40 (43%)
Hypertension SBP≥140mmHg	17 (18.3%)
Hypotension (SBP <100mmHg)	10 (10.7%)
Fever ≥37.3	12 (12.9%)
Bradycardia (HR<60 /min)	2 (2.2%)
Other	
*GCS ≤ 8	18 (19.4%)

*Indications for mechanical ventilation based on an article by Christopher D Jackson et al(25)

Laboratory findings

Abnormal potassium levels (Hypokalaemia and hyperkalaemia) was observed in 12 (12.9%) and 21 (23.5%) of patients respectively. Elevated lactate levels were seen in 46 (66.7%) patients. 53 (56.9%) patients had acidosis, 24 (36.4%) had PCO2 of more than 45 and anaemia was observed among 9 (10.7%). **Table 4**.

Table 4: Laboratory results among non-traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital

Laboratory results	**n (%)**
Na+(mEq/L) (n=92)	
< 135	32 (34.7%)
> 145	10(10.8%)
K+ (mEq/L) (n=85)	
< 3.5	11 (12.9%)
>5	20 (23.5%)
Cl^- (mEq/L) (n=93)	
< 96	21 (22.6%)
> 106	27 (29%)
PH (n=93)	
< 7.35	53 (56.9%)
> 7.45	7 (7.5%)
HCO3 (mEq/L) (n=67)	
< 22	38 (56.7%)
PCO2 (n=66)	
< 35	12 (18.2%)
> 45	24 (36.4%)
Anion Gap (mmol/L) (n=93	
> 12	84 (90.3%)
Lactate (mEq/L) (n=69)	
>2	46 (66.7%)
Hb (g/dl) (n=84)	
≤ 7	9 (10.7%)
Creatinine (umol/L) (n=60)	
> 120	23 (38.3%)
BUN (mmol/L) (n=82)	
> 7.1	33 (40.2%)

∗Laboratory normal and cut of points values are as per Muhimbili National Hospital Machine calibrated values

ED management

On EMD management given, 93 (100%) received oxygen therapy, 61 (65.5%) received fluid resuscitation of whom 36 (60.2%) received less than 1L of fluid resuscitation. Six (6.5%) received blood transfusion and 10 (10.8%) received vasopressor support. 48(51.6%) received mechanical ventilation of whom 25(52.1%) were intubated and 23(47.9%) received CPAP(**Table 5).**

Table 5:EMD management given among non-traumatic patients with indications for mechanical ventilation attending the EMD at Muhimbili national hospital

Management	**N=93** **n (%)**
Oxygen therapy	
Received	**93 (100%)**
Did not receive	0 (0%)
IV fluids	
Normal saline	**59(63.4)**
Ringers lactate	2(2.1)
Volume of IV fluids	
<1000mls	**36(38.7)**
1000-2000mls	25(26.8)
Blood transfusion	
Given	6(6.5)
Vasopressor support	
Given	10(10.8)
Mechanical ventilation	
CPAP	22(45.8)
Invasive	**26(54.2)**

Outcome

Overall mortality for the study group was 30.1% (28 patients). Mortality among patients who did not receive mechanical ventilation 17(37.8%). Patients with ED length of stay of more than 4 hours was observed among patients who received mechanical ventilation 31(64.6%) of the 48 patients. Most of the patients in the study population were admitted to ICU 63(67.7%) including 36(75%) of those who received either form of mechanical ventilation.Length of hospital stay was similar between those who received mechanical ventilation and those who did not receive.**Table 6**

Table 6: Outcomes of patients with indications for mechanical ventilation

Outcome	**Received n (%)**	**Did not receive n (%)**	**Total Frequency N (%)**
Overall mortality	11(22.9)	17(37.8)	28(30.1)
***ED LOS (Hours)**			
≤4	17(35.4)	20(44.4)	37(39.8)
>4	31(64.6)	25(55.6)	56(60.2)
Disposition			
ICU	36(75)	27(60)	63(67.7)
Cardiac	7(14.65)	8(17.8)	15(16.1)
Nephrology	3(6.3)	5(11.1)	8(8.6)
Medical	2(4.2)	5(11.1)	7(7.5)
HOSP LOS (days)			
≤7	24(50)	23(51.1)	47(50.5)
>7	24(50)	22(48.9)	46(49.5)

***ED LOS -By Hung et al(4)

A longer duration of mechanical ventilation was seen in a patient with CVA, 22 days followed bypatients with diabetes, median 4days (IQR 3-32). Age, sex, insurance coverage, and disease category had short duration of mechanical ventilation.**(Table 7).**

Table 7: Distribution of duration of mechanical ventilation with demographic variable

Variable	Duration of ventilation in days Median(IQR)
Age (years)*	
<65	3(IQR2-5)
>65yrs	2(IQR2-3)
Sex	
Male	2.5(IQR2-3)
Female	3.5(IQR3-5)
Insurance	
Insured	3(IQR1-5)
Not insured	3(IQR2-4)
Disease category	
Non infectious	2.5(IQR2-3)
Infectious	3(IQR2-3)
Disease diagnosis	
CVA/TIA	22(IQR0-0)
PUD	3(IQR1-5)
Immunosuppression	2.5(IQR2-3)
End stage kidney disease	3(IQR2-3)
Diabetes	4(IQR3-32)
Heart failure	3(IQR3-4)
None	2.5(IQR2-6)
Hypertension	3(IQR2-5)

∗Reference as per a study done by Combes A et al (42)

Patients who did not receive mechanical ventilation had higher mortality compared to those who received ventilation (60.7 % vs. 39.3%) but the association was not statistically significant**,** p-value 0.125. Length of Hospital stay was similar for patients received mechanical ventilation and those who did not receive mechanical ventilation, p-value 0.914.**Table 8**

Table 8: Association of the outcome to the mechanical ventilation status

	Mechanical ventilation status		
	Yes	**No**	**p-value**
Character (s)			
Mortality			0.125
Yes	11 (39.3)	17 (60.7)	
No	37 (56.9)	28 (43.1)	
***LOS (Hospital)**			0.914
< 7 days	24(51.1)	23 (48.9)	
> 7days	24(52.2)	22 (47.8)	

∗Outcome duration as described by Fu et al(43)

Factors associated with poor outcome among patients undergoing mechanical ventilation at ED - MNH

Mortality occurred in (25%) of male patients and 20% of female patients. Most patients in the study were < 65 years, and 11 (23.4%) of them died while the one subject over 65 years survived. A slightly higher mortality was seen among patients who were not insured (23.5%) and increased mortality was observed in those with ED LOS >4hours 10(32.3%). However, further analysis had shown that Saturation of >95%, low GCS, invasive type of mechanical ventilation and abnormal K+ levels were significantly associated with mortality, p-value 0.039, 0.038, 0.034 and 0.005 respectively. Among patients received mechanical ventilation, 26 were intubated and 22 received CPAP. 10 of those intubated died and only 1 of those on CPAP died (RR=8.462, p=0.034).**Table 9:**

Table 9: Factors associated with poor outcome among patients receiving mechanical ventilation at ED - MNH

Characteristics	Mortality		RR	p-value
	Yes	No		
Sex			1.25	0.687
Male	7 (25)	21 (75)		
Female	4 (20)	16 (80)		
Age *			0.958	0.972
< 65	11 (23.4)	36 (76.6)		
>65	-	1 (100)		
Insurance			1.042	0.075
Insured	4 (22.6)	13 (76.5)		
Not insured	7 (23.5)	24 (77.4)		
Comorbidities			0.650	0.422
Yes	7 (20)	28 (80)		
No	4(30.8)	9(69.2)		
O2 saturation (%)			**0.324**	**0.039**
<90	4 (13.3)	26 (86.7)		
>95	7 (41.2)	10 (58.8)		
GCS			**2.914**	**0.038**
≤8	6 (42.9)	8 (57.1)		
≥9	5(14.7)	29(85.3)		
PH			0.52	0.212
<7.35	7(18.9)	30(81.1)		
>7.35	4(36.4)	7(63.6)		
Lactate			2.00	0.322
>2	9(33.3)	18 (66.7)		
<2	2(16.7)	10(83.3)		
Creatinine			1.8	0.243
>120	7 (41.2)	10 (58.8)		
<120	4(22.2)	14(77.8)		
K+ levels			**4.036**	**0.005**
Abnormal	6 (54.5)	5 (45.5)		
Normal	5(13.5)	32(86.5)		
Hb level(g/dl)			1.157	0.779
<9	5(27.8)	13(72.2)		
>9	6(24)	19(76)		
***ED LOS (HRS)**			5.484	0.09
≤4	1(5.9)	16(94.1)		
>4	10(32.3)	21(67.7)		
Mechanical ventilation			**8.462**	**0.0341**
Invasive	10(38.5)	16(61.5)		
Non invasive	1(4.5)	21(95.5)		

The normal values and cut of points are as defined by the WHO and Medscape

* reference for ED LOS as per a study done by Combes A et al (42)

CHAPTER FOUR

4.0 DISCUSSION

This studyconducted in our setting at EMD MNH describes the clinical profiles and outcome of patients with indications for mechanical ventilation. The first important finding is that not everyone with indicationsreceived mechanical ventilation**, which is also the case in other low-income countries. There is a need for mechanical ventilation in critically ill patients presenting at ED but there are scarce resources including availability of ventilators**(5)(20)(34)**.**

In high income country, a study done on mechanical ventilation, had some similarities on the characteristics, reasons for the need for mechanical ventilation, the primary outcome of the study which is mortality and length of hospital stay (33). The difference here is that there are available resources for those in need, including ventilator machines. So, they all received mechanical ventilation.

In this study, nearly all patients were under 65 years, and the numbers of male and female patients were pretty similar. More than half of the patients were referred, most had no insurance and had comorbidities. In a study done in a high-income country, the median age was 69 (IQR 54-75 years) and males predominated 58%. The study did not include referral status, insurance status, or comorbidities in the demographics(33).

Inour study in LIC, clinical characteristics that bring for the need for mechanical ventilation were hypoxia, increased work of breathing, reduced work of breathing, tachycardia and low GCS levels. This is the same as in HIC, patients present to the emergency department (ED) with hypoxia, low level of consciousness hence unable to protect airway, increased work of breathing, reduced work of breathing or apnoea due to a wide range of conditions that may require tracheal intubation or positive pressure ventilation, including: pneumonia, asthma, chronic obstructive pulmonary disease (COPD), cardiogenic pulmonary oedema, acute respiratory distress syndrome, stroke, trauma, drug overdose, severe sepsis, shock, and neuromuscular disorders such as myasthenia gravis or Guillain-Barre syndrome (25)(33)(44).

In our study hypertension, heart failure and diabetes were the leading comorbidities. In high income countries hypertension and diabetes were also among the leading comorbidities preceded by chronic kidney diseases and coronary artery diseases(45).

The median duration of mechanical ventilation was 2.5(IQR2-7days)however 22days was observed in patients with a CVA. In high income countries, the duration of mechanical ventilation was observed to range from 2.6 to 7.9 days (8) and in another study the median duration of mechanical ventilation was 7days (33).

In a middle income country, it was shown that increased age and comorbidities were independently associated with increased mortality (34). However, in a study done in HIC it has shown that readmission and immune-compromised status and increased age >65years has been associated with mortality (33). This is different from the findings of our study which showed the low GCS level of less than 8, abnormal potassium levels and intubation were associated with increased mortality.

Several other studies have been done to evaluate the relationship between mechanical ventilation status to the primary outcome of mortality, but most of these studies have been done on a particular medical condition such as ARDS. Fuller et al studied mechanical ventilation in patients with ARDS in the ED, where the mortality was 51.1% (7).
In our study, the overall mortality for patients with indication for mechanical ventilation was 30.1%.

Among those who received mechanical ventilation, in our study, factors associated with poor outcome were factors present at the start of mechanical ventilation, which are low level of consciousnessand abnormal potassium levels. In HIC the study done by Esteban et al has shown the same. The main conditions independently associated with increased mortality were factors present at the start of mechanical ventilation (44)**. Patients who were intubated in our study had increased mortality compared to those who received CPAP. In another study performed in LIC by Chiwane et al, patients on invasive mechanical ventilation had increased mortality 77%(34). In high income countries the outcome is different. There has been improvement in outcome of patients receiving mechanical ventilation as it has been seen in study done by**

Esteban et al on evolution of mortality overtime in patients receiving mechanical ventilation(46)**.However, another study done by Sanchez et al showed that mortality was high 44(27%) after ED intubation** (27)**.**

In the study done by Angoti et al on duration of mechanical ventilation at ED there was an increase in mortality in patients staying in ED for more than 7hours (45.9%) as compared to those staying in ED for less than 7hours (29.4%)(8)**. In our study we found that a higher percentage of patients who received mechanical ventilation stayed more than four hours than the proportion that did not receive it, but staying longer than four hours was not associated with high mortality.**

4.1 Study limitations

This was a single centre study, and therefore it is subject to all shortcomings of single centre studies including limited external validity. Convenience sampling was used; hence the sample may not be fully representative of the study population. The small number of patients limits the ability to perform multivariate analysis. As an observational study, we cannot determine cause-effect relationships.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Mechanical ventilation is one of the important interventions in critically ill patients presenting at the Emergency Department. In this study in LIC, we found that half of those in need of mechanical ventilation did not receive it, likely due to scarce resources, and the group receiving no mechanical ventilation was more likely to die. Half of those who received mechanical ventilation were intubated and the rest received non-invasive ventilation. Those intubated had worse outcome than those receiving non-invasive ventilation, probably because they were the sickest patients and they are more likely to die or have complications relating to invasive ventilation.A low GCS≤8 and abnormal potassium levels were also observed to be predictors of mortality.

5.2 Recommendations

Future studies should focus to identify the reason for poor outcome among those intubated.

Provision of local department protocol on mechanical ventilationas those intubated had poor outcome.

Additional ED resources including ventilators to help with the demand as half of those in need did not receive any mechanical ventilation due to scarce resources.

Multicentred study with a large sample size is recommended to address the shortcomings encountered in this single centre study.

REFERENCES

1. Rivers EP, Nguyen HB, Huang DT, Donnino MW. Critical care and emergency medicine. Curr Opin Crit Care. 2002 Dec;8(6):600–6.

2. Green RS, MacIntyre JK. Critical care in the emergency department: an assessment of the length of stay and invasive procedures performed on critically ill ED patients. Scand J Trauma Resusc Emerg Med. 2009 Sep 24;17:47.

3. Easter BD, Fischer C, Fisher J. The use of mechanical ventilation in the ED. Am J Emerg Med. 2012 Sep;30(7):1183–8.

4. Hung S-C, Kung C-T, Hung C-W, Liu B-M, Liu J-W, Chew G, et al. Determining delayed admission to intensive care unit for mechanically ventilated patients in the emergency department. Crit Care Lond Engl. 2014 Aug 23;18(4):485.

5. Marsh RH, Rouhani SA. Gaps in physical access to emergency care in sub-Saharan Africa. Lancet Glob Health. 2018;6(3):e240–1.

6. Fuller BM, Mohr NM, Drewry AM, Carpenter CR. Lower tidal volume at initiation of mechanical ventilation may reduce progression to acute respiratory distress syndrome: a systematic review. Crit Care Lond Engl. 2013 Jan 18;17(1):R11.

7. Fuller BM, Mohr NM, Miller CN, Deitchman AR, Levine BJ, Castagno N, et al. Mechanical Ventilation and ARDS in the ED. Chest. 2015 Aug;148(2):365–74.

8. Angotti LB, Richards JB, Fisher DF, Sankoff JD, Seigel TA, Al Ashry HS, et al. Duration of Mechanical Ventilation in the Emergency Department. West J Emerg Med. 2017 Aug;18(5):972–9.

9. Osei-Ampofo M, Aidoo A, Antwi-Kusi A, Joan Ofungwu O, Kotey SN-K, Siaw-Frimpong M, et al. Respiratory failure requiring mechanical ventilation in critically ill adults in Ghana: A prospective observational study. Afr J Emerg Med. 2018 Dec;8(4):155–7.

10. Needham DM, Yang T, Dinglas VD, Mendez-Tellez PA, Shanholtz C, Sevransky JE, et al. Timing of low tidal volume ventilation and intensive care unit mortality in acute respiratory distress syndrome. A prospective cohort study. Am J Respir Crit Care Med. 2015 Jan 15;191(2):177–85.

11. Tobin MJ. Mechanical Ventilation. N Engl J Med. 1994 Apr 14;330(15):1056–61.

12. Serpa Neto A, Cardoso SO, Manetta JA, Pereira VGM, Espósito DC, Pasqualucci M de OP, et al. Association between use of lung-protective ventilation with lower tidal volumes and clinical outcomes among patients without acute respiratory distress syndrome: a meta-analysis. JAMA. 2012 Oct 24;308(16):1651–9.

13. Pham T, Brochard LJ, Slutsky AS. Mechanical Ventilation: State of the Art. Mayo Clin Proc. 2017;92(9):1382–400.

14. Emergency Airway Management Part 5: Post intubation care [Internet]. First10EM. 2018 [cited 2020 Feb 2]. Available from: https://first10em.com/post-intubation/

15. Chalfin DB, Trzeciak S, Likourezos A, Baumann BM, Dellinger RP, DELAY-ED study group. Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. Crit Care Med. 2007 Jun;35(6):1477–83.

16. Rose L, Gray S, Burns K, Atzema C, Kiss A, Worster A, et al. Emergency department length of stay for patients requiring mechanical ventilation: a prospective observational study. Scand J Trauma Resusc Emerg Med. 2012 Apr 11;20:30.

17. Rose L. Management of critically ill patients receiving noninvasive and invasive mechanical ventilation in the emergency department. Open Access Emerg Med OAEM. 2012;4:5–15.

18. Fromm RE, Gibbs LR, McCallum WG, Niziol C, Babcock JC, Gueler AC, et al. Critical care in the emergency department: a time-based study. Crit Care Med. 1993 Jul;21(7):970–6.

19. Wen LS, Geduld HI, Nagurney JT, Wallis LA. Africa's first emergency medicine training program at the University of Cape Town/Stellenbosch University: history, progress, and lessons learned. Acad Emerg Med Off J Soc Acad Emerg Med. 2011 Aug;18(8):868–71.

20. Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C, Joshipura M. Emergency medical systems in low- and middle-income countries: recommendations for action. Bull World Health Organ. 2005 Aug;83(8):626–31.

21. Young JD. Modes of ventilation. Curr Opin Anesthesiol. 1989 Dec;2(6):796–799.

22. Emergence Medicine Department [Internet]. [cited 2020 Feb 2]. Available from: http://www.mnh.or.tz/index.php/directorates/medical-services/emergence-medicine-department

23. Santanilla JI, Daniel B, Yeow M-E. Mechanical ventilation. Emerg Med Clin North Am. 2008 Aug;26(3):849–62, x.

24. Overview of Mechanical Ventilation - Critical Care Medicine [Internet]. MSD Manual Professional Edition. [cited 2020 Feb 2]. Available from: https://www.msdmanuals.com/professional/critical-care-medicine/respiratory-failure-and-mechanical-ventilation/overview-of-mechanical-ventilation

25. Mechanical Ventilation: Background, Classifications of Positive-Pressure Ventilators, Indications for Mechanical Ventilation. 2019 Nov 12 [cited 2020 Feb 2]; Available from: https://emedicine.medscape.com/article/304068-overview

26. Slutsky AS. History of Mechanical Ventilation. From Vesalius to Ventilator-induced Lung Injury. Am J Respir Crit Care Med. 2015 May 15;191(10):1106–15.

27. Sanchez LD, Goudie JS, De la Pena J, Ban K, Fisher J. Mortality after emergency department intubation. Int J Emerg Med. 2008 Jun;1(2):131–3.

28. Page D, Ablordeppey E, Wessman BT, Mohr NM, Trzeciak S, Kollef MH, et al. Emergency department hyperoxia is associated with increased mortality in mechanically ventilated patients: a cohort study. Crit Care Lond Engl. 2018 18;22(1):9.

29. Quinten VM, van Meurs M, Olgers TJ, Vonk JM, Ligtenberg JJM, ter Maaten JC. Repeated vital sign measurements in the emergency department predict patient deterioration within 72 hours: a prospective observational study. Scand J Trauma Resusc Emerg Med [Internet]. 2018 Jul 13 [cited 2020 Feb 2];26. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6045840/

30. Brekke IJ, Puntervoll LH, Pedersen PB, Kellett J, Brabrand M. The value of vital sign trends in predicting and monitoring clinical deterioration: A systematic review. PLoS ONE [Internet]. 2019 Jan 15 [cited 2020 Feb 6];14(1). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6333367/

31. Rapid Response Systems SID • LITFL • CCC Cardiology [Internet]. [cited 2020 Feb 2]. Available from: https://litfl.com/rapid-response-systems/

32. Fuller BM, Ferguson IT, Mohr NM, Drewry AM, Palmer C, Wessman BT, et al. Lung-Protective Ventilation Initiated in the Emergency Department (LOV-ED): A Quasi-Experimental, Before-After Trial. Ann Emerg Med. 2017 Sep;70(3):406-418.e4.

33. Jeong B-H, Suh GY, An JY, Park MS, Lee JH, Lee M-G, et al. Clinical Demographics and Outcomes in Mechanically Ventilated Patients in Korean Intensive Care Units. J Korean Med Sci. 2014;29(6):864.

34. Chiwhane A, Diwan S. Characteristics, outcome of patients on invasive mechanical ventilation: A single center experience from central India. Egypt J Crit Care Med. 2016 Dec 1;4(3):113–8.

35. Marley RA, Simon K. Lung-Protective Ventilation. Annu Rev Nurs Res. 2017;35(1):37–53.

36. Said AT. Knowledge and practice of intensive care nurses on prevention of ventilator associated pneumonia at Muhimbili national hospital, Dar es Salaam, Tanzania [Internet] [Thesis]. Muhimbili University of Health and Allied Sciences; 2012 [cited 2020 Feb 2]. Available from: http://dspace.muhas.ac.tz:8080/xmlui/handle/123456789/588

37. Developing a Conceptual Framework for Research (Sample) [Internet]. Scribbr. 2015 [cited 2020 Feb 2]. Available from: https://www.scribbr.com/dissertation/conceptual-framework/

38. Bernhard M, Bax SN, Hartwig T, Yahiaoui-Doktor M, Petros S, Bercker S, et al. Airway Management in the Emergency Department (The OcEAN-Study) - a prospective single centre observational cohort study. Scand J Trauma Resusc Emerg Med. 2019 Feb 14;27(1):20.

39. Ghosh R, Pepe P. The critical care cascade: a systems approach. Curr Opin Crit Care. 2009 Aug;15(4):279–83.

40. Jung JY. Airway management of patients with traumatic brain injury/C-spine injury. Korean J Anesthesiol. 2015 Jun;68(3):213–9.

41. Kornblith L, Kutcher M, Callcut R, Redick B, Hu C, Cogbill T, et al. Mechanical ventilation weaning and extubation after spinal cord injury: A Western Trauma Association multicenter study. J Trauma Acute Care Surg. 2013 Dec 1;75:1060–70.

42. Combes A, Costa M-A, Trouillet J-L, Baudot J, Mokhtari M, Gibert C, et al. Morbidity, mortality, and quality-of-life outcomes of patients requiring >or=14 days of mechanical ventilation. Crit Care Med. 2003 May;31(5):1373–81.

43. Fu K-H, Chen Y-R, Fan J-S, Chen Y-C, Huang H-H, How C-K, et al. Emergency department critical care unit for critically ill cardiovascular patients: An observation study. J Chin Med Assoc JCMA. 2017 Apr;80(4):233–44.

44. Esteban A, Anzueto A, Frutos F, Alía I, Brochard L, Stewart TE, et al. Characteristics and outcomes in adult patients receiving mechanical ventilation: a 28-day international study. JAMA. 2002 Jan 16;287(3):345–55.

45. Seneff MG, Zimmerman JE, Knaus WA, Wagner DP, Draper EA. Predicting the duration of mechanical ventilation. The importance of disease and patient characteristics. Chest. 1996 Aug;110(2):469–79.

46. Esteban A, Frutos-Vivar F, Muriel A, Ferguson ND, Peñuelas O, Abraira V, et al. Evolution of mortality over time in patients receiving mechanical ventilation. Am J Respir Crit Care Med. 2013 Jul 15;188(2):220–30.

APPENDICES

Appendix 1.Case report Form

INCLUSION CRITERIA: All adult patients who present to the Emergency Medicine Department of Muhimbili National Hospital and triaged to resuscitation rooms and has indications for mechanical ventilation. Trauma patients will be excluded.

Code no: _____

Date of EMD visit: _____
Time of ED arrival: _____
Length of ED stay: _____
In-Hospital LOS: _____
Date of Discharge: _____

DEMOGRAPHICS:

Age: _____

Sex:

☐Male

☐Female

Marital status:

☐Married

☐Single

☐Divorced

☐Widow/Widower

Occupation:

☐Employed

☐Self-employed

☐Unemployed

☐Retired

Referral status:

☐Public

☐Private

☐Self------- ☐Others: _____

Insurance status:

☐Insured

☐Cash paying/public

Disease category of patient:

☐Medical infectious

☐Medical Non-Infectious

Triage level:

☐Emergency

☐Priority

☐Non-medical Trauma ☐Queue

☐Non-Medical Gynaecology

☐Non-Medical-Surgery

☐**Specific diagnosis**

ED Diagnosis_____

In-hospital diagnosis_____

Mode of Transport:

☐Ambulance

☐Private

☐Public

CLINICAL PROFILE:

Physiological Parameters:

SBP: _____mmHg DBP: _____mmHg RR: _____/min

HR: _____BPM Temp: _____◦C SPO_2: _____ GCS: _____

Comorbidities:

☐H/o UGIB ☐H/o renal failure ☐HIV

☐H/o Liver disease ☐H/o Cardiac failure ☐H/o Malignancy

☐H/o Diabetes ☐H/o Hypertension ☐myocardial infarction

☐COPD ☐Peripheral vascular disease ☐CVA/TIA

☐Dementia ☐hemiplegia ☐connective tissue disease

☐Peptic ulcer disease.

POC Lab Results:

Lactate: _____ mmol/l

Drawn at L ☐<2 hrs from arrival ☐2-4
☐>4

Hb Level: _____ g/dl Urea: _____Creatinine: _____PH: _____

Base deficit: _____AG: _____ Na+: _____K+: _____

CL- : _____ Ca^{2+}: _____ Hco3_____ PCO2____ PH_____

EMD MANAGEMENT AND DISPOSITION:

Fluid resuscitation: Type of Fluid?
☐NS
☐RL
☐Others

Volume Infused?
☐<1000mls
☐1000-2000mls
☐2000-3000mls
☐>4000mls

Blood Transfusion:
☐Yes
☐No

Units given:
☐1-2 units
☐3-4 units
☐>4 units

Vasopressor support:
☐Yes
☐No

Mechanical ventilator support.
☐Yes
☐No
CPAP_____?ETT_____?

Oxygen therapy

☐ Received

☐ Did not receive

Haemostasis Measures provided:

☐Yes ☐No

ED disposition plan:

☐Ward specify: _____

☐ICU
☐Surgery
☐DAMA
Died in ED

MORTALITY:

Did the patient die within 24 hours?

☐Yes

If yes, please specify location:

☐EMD/ward/ICU

Appendix 2. CONSENT FORM (English version)

STUDY TITLE: Profile and outcome of patients with indications for receiving mechanical ventilation in the emergency medicine department of Muhimbili National Hospital.

Introduction

Greetings, my name is Dr. Ntevona S. Mtera, a second-year resident in the course of Emergency Medicine at Muhimbili University of Health and Allied Sciences (MUHAS).

I am conducting a study with the above title as part of my study program. I hereby request your participation and cooperation in my study once I or my research assistant approaches you. Your decision to/not to participate will have no effect on the care and management or harm to your patient or beloved one whatsoever.

Please ask questions if there is anything about this study you do not understand.

Aim of the study

The purpose of this study is to describe Profile and outcomes of adult patients with indications for mechanical ventilation at Emergency Medical Department, Muhimbili National Hospital.

Benefits

There will be overall benefit after knowing the results and its implication to the hospital. There will be no payment for participation in the study.

Risks

There is no risk in participating in this study.

What does this study involve?

This study involves the research assistant or principal investigator asking structured questions to the informant or relatives and filling the responses in the prepared questionnaire. Also, information about the patient will be obtained from the patients file.

Consent

Your consent/Consent for your patient to be involved in the study is completely voluntary and agreeable by signing the consent form. If you are not free you are allowed not to

consentand this will not affect the care and management offered to your patient you brought for treatment. You may choose to stop taking part in this study at any time for any reason.

Confidentiality

The information you provide is highly valued and will be kept strictly confidential. The study information will be stored in protected computer files and in paper records stored in locked filing cabinet. Only study staff will have access to the information.

Access of information.

By signing this form, you allow the research team to use the information and give it to others involved in the research. The research team includes the researcher, facilitators plus others working on this study at MUHAS and MNH.

For further information, questions or queries, you can contact:

1. The Principal Investigator,
   Dr. Ntevona S Mtera,
   Department of Emergency Medicine,
   MUHAS/MNH,
   P.O. BOX 65001,
   Dar-es salaam, Tanzania.
   Tel: +255 717964172,
   Email: mterantevona@gmail.com

2. Dr. Hendry Sawe

Department of Emergency Medicine,
MUHAS/MNH,
P. O. Box 65001,
Dar es Salaam, Tanzania.
Tel: +255 754 885658
Email: hendry_sawe@yahoo.com

3. Bruno Sunguya
   Director of Research and Publications,
   MUHAS,
   P.O. Box 65001,
   Dar es Salaam, Tanzania.

Signature:

I, _____ have read/been told the contents of this form. My questions have been answered. I agree to participate in this study.

Signature of participant _____

Date of signed consent _____

Kiambatanisho 3. FOMU YA RIDHAA - Kiswahili

Utangulizi

JinalangunaitwaDktNtevona S Mtera, mwanafunziwaudaktaribingwawa**magonjwa ya dharura** katika Chuo Kikuu Cha Afya naSayansiShirikishi Muhimbili (MUHAS). Ninaombaushirikiwakokwaniaba ya mgonjwawako katika utafitihuuendapomimiamamsaidiziwanguatakapokufuatailikukuulizataarifamuhimuzamgonjwawako.

Madhumuni ya utafiti

Utafiti huuunalengakuangaliawasifunamatokeouingizajihewamitambowanayopatawagonjwawaliofika katika idara ya dharura.

Ushiriki katika utafiti

Mgonjwayeyotealiyefikaidaranikwaajili ya matibabuakiwanauhitajiwahewamitambo.

Hatari

Hatutarajiikuweponaathari/hatariyeyoteitokanayonaushiriki katika utafitihuu.

Faidazautafiti

Kwakutoa ridhaa ya mgonjwawakokushirikishwa katika utafitihuu, tutawezajuanisababuzipinahatarizipizinawezakupelekeamgonjwamoyokusimama/kufa, tibazinazowezakuokoamgonjwa, nahatmazawagonjwahawabaada ya tiba ya dharura.

Usiri

Taarifazotezitakazokusanywa katika utafitihuuzitakuwasiri, hivyoushirikiwakohautajulikananamtu. Taarifahizizitajulikanakwenyetimu ya watafititu.

Malipo

Kwa kushiriki kwenyeutafitihuu, hautalipwawalahautalipagharamayeyote.

Ukiwanaswali au tatizololote, unawezakuwasilianawafuatao:

1. Mkuuwa Utafiti

Dkt. Ntevona S Mtera,

Idara ya Magonjwa ya DharuranaMahututi ,

MUHAS,

S.L.P 65001,

Dar es Salaam, Tanzania.

Simu: +255 717964172

Baraupepe: mterantevona@gmail.com

2. Dkt. Hendry R Sawe,

Idara yaMagonjwa ya dharuranaMahututi,

MUHAS/MNH,

S.L.P 65001,

Dar es Salaam, Tanzania.

Tel: +255 754 885658

Baruapepe: hendry_sawe@yahoo.com

3. Bruno Sunguya

Mwenyekitiwakamati ya utafiti ya chuo,

S.L.P 65001,

Dar es salaam, Tanzania

Kuwekasahihi ya makubaliano:

Mimi, _____,

nimesoma/nimesomewamaelezoyoteyaliyomokwenyefomuhiinanimeelewa. Maswali yanguyamejibiwavizurinanikotayari kushiriki.

Sahihi ya mshiriki _____

Sahihi ya Mtafiti _____