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SCHOOL OF MEDICINE AND PHARMACY

EPIDEMOLOGY AND OUTCOMES OF CRITICALLY ILL PATIENTS IN EMERGENCY DEPARTMENT AT KIGALI UNIVERSITY TEACHING HOSPITAL (CHUK)

Thesis submitted in partial fulfillment of the requirement for the Award of Master of Medicine in Emergency Medicine and Critical Care at the College of Medicine and Health Sciences, University of Rwanda.

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September, 2022

DECLARATION

DECLARATION

I, KAMUNGA BADIBANGA Laurent Gamy, hereby declare and certify that the work presented in this dissertation entitled "**Epidemiology and Outcomes of Critically Ill Patients in Emergency Medicine at Kigali University Teaching Hospital**" is entirely my original work and it has never been presented or submitted in a whole or in part to any other university.

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Date: 08/09/2022

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We, hereby declare that this dissertation has been submitted with our approval as supervisors.

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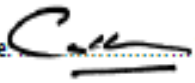
Dr. __Giles N Cattermole_____ Signature:  Date: ...10../Sep/2022

DEDICATION

I dedicate this thesis to the almighty God for His mercy and grace. In addition, I dedicate this study to my family members, for their spiritual, financial and moral support.

To you my dear father, I thank you for everything you do for me.

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This study would not have been finalized without the moral and intellectual support from different people to whom I would like to express my heartfelt gratitude.

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ABSTRACT

Background and Objectives: The introduction of Emergency Medicine in Rwanda in 2013 has been associated with a mortality reduction in critically ill patients presenting to CHUK. However, while awaiting available Intensive Care Unit (ICU) beds, very sick patients often board in the Emergency department. The aim of this study is to: 1) identify the rate of critically ill patients in ED at CHUK, 2) assess the outcomes of those patients, 3) assess the types of critical management provided to them in ED at CHUK, and 4) determine factors associated to outcomes in critically ill patients.

Methods: A descriptive prospective cohort study analyzed all patients ≥15 years who presented to CHUK between April and June 2022 with modified South African Triage Scores of Red with alarm, Red without alarm, and Orange.

Results: Of 320 patients, 66.9% were male and median age was 40 years. Patients were triaged as Orange (65.3%), Red without alarm (22.8%), and Red with alarm (11.9%). Presentations were categorized as: medical emergencies (47.1%), traumatic injury (44.1%), and surgical emergencies (7.5%). Mortality was 12.2% and highest among medical emergencies (16.5%, $p=0.046$) and increased significantly with triage color ($p<0.001$): Red with alarm (46.1%), Red without alarm (30.8%) and Orange (23.1%). CPR (10.3%) and endotracheal intubation (8.8%) were the most frequent critical interventions provided. Median length of stay was 33.5 hours and boarding time was 22.2 hours. Length of stay was statistically associated with mortality ($p=0.024$). In addition, mortality was associated with the following interventions: CPR, intubation, and use of vasopressors ($p<0.05$).

Conclusions: Our study shows high mortality rate despite providing critical management, which can be attributed to prolonged length of stay. Due to limitations, this pilot study is recommended to be extended to other hospital departments for longer periods and to understand factors predicting mortality such that they can be addressed at systems level.

Key words: Critically ill patients, length of stay, boarding time, critical management, mortality.

CHAPTER ONE: INTRODUCTION

1.1. Introduction

This part is comprised with background, problem statement, aim and objectives, research question and the study structure.

1.2. Background

Patients arriving to the emergency department (ED) have differing requirements for urgent medical treatment. To prioritize some patients over others is often demanded in context limited hospital resources. Overcrowding is a frequent and escalating problem in the ED, which can lead to adverse patient outcomes (1).

Efficacious and aggressive resuscitation is required for critically ill patients when they present to the ED. With the lack of ICU beds at CHUK, very sick patients are managed in the ED with increased regularity. In the United States a study showed that, with a length of stay from 2.5 to 18 hours among overall patients, critically ill patients were presented to the ED at more than 8% and admitted to the hospital at more than 25% (2).

As a result, EDs must rapidly establish the urgency and level of care required for individual patients in an effort to optimize allocation of sparse hospital resources. In order to obtain this objective, a majority of modern EDs utilize a triage tool to assess patients' severity of illness or injury at arrival, determine priorities, and then deliver appropriate treatment (3). Scale-based protocols guide healthcare providers when labelling patients according to their required level of care but accuracy is strongly influenced by the experience of the triaging doctor or nurse (3).

1.3. **Problem statement**

ED overcrowding is one of the most crucial public health challenges (12). Currently literature has found that ED crowding and increased hospital length of stay(LOS) are associated with hospital mortality (8)(9)(12)(13). For instance, one study found that patients on mechanical ventilation with a ED boarding time (EDB) more than 6 hours were almost 6 times more likely to die (13).

An ED study performed in Rwanda by Uwamahoro et al from August 2015 to July 2016 showed that the mortality rate increases with category of triage. It was shown that mortality rate of 'Red with alarm' patients was 7.7% versus 6.6% for 'Red without alarm' and 1.1%, 0.2% and 0% respectively for Orange, Yellow and Green patients (4). That study looked at mortality in the ED according to triage category, but did not describe the ED length of stay (EDLOS), the EDB and

disposition of critically ill patients, nor did not describe the critical interventions performed in these patients. Moreover, to our knowledge, no existing literature examines the impact of the above cited factors (length of stay, boarding time) in the ED at CHUK.

1.4. The aim of the study

This study aims, based on the EDLOS, to assess the epidemiology and the ED outcomes of critically ill patients at CHUK.

1.5. Research objectives

- To identify the rate of critically ill patients in ED at CHUK
- To assess the outcomes of these patients in ED at CHUK
- To assess the types of critical management provided to them in ED at CHUK
- To determine which factors are associated with outcomes in very sick patients at ED

1.6. Research questions

What are the epidemiology and the outcomes of critically ill patients in the ED at CHUK?

1.7. Significance of the study

This study will enable the hospital management in implementing appropriate strategies with the purpose to increase competency of ED medical staff to deliver care efficiently to critically ill patients and for in hospital team to improve the critically ill patients' flow in the ED.

1.8. Definition of Concepts

Critically ill patient: one who experiences a life-threatening multisystem process which can lead to considerable morbidity and mortality, and mostly is often preceded by a period of physiological degradation.

1.9. Structure/Organization of the study

This report is structured as follows: an introductory chapter providing background and rationale for study objectives, a literature review exploring existing research in the topic area, a methodology providing details of study design, approach, and tools of data collection. The report concludes with

a result chapter discussing the findings of the present study against the existing studies done in different perspectives related to the current study and recommendation based on such findings.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This part deals with Theoretical Literature, Empirical Literature, Critical Review and identification of gaps in existing literature.

2.2. Theoretical Literature

Triage systems are actually applicable to any type of patients presenting care in modern emergency care facility. Triage tools developed in High Income Countries (HIC) have been found to lack applicability in Low and Middle Income countries (LMIC). Therefore, in LMIC, the Triage Early Warning Score (TEWS) was developed as an applicable score for triage use in context of low settings such as in Africa. The TEWS is a part of the South African Triage Scale (SATS), which has been utilized and analyzed in different countries in sub-Saharan Africa such as South Africa, Ghana, Somaliland, Malawi and Rwanda (1)(4).

Since emergency medicine (EM) specialty training was instituted in Rwanda in 2013 (5), many changes have occurred in the management and delivery of emergency care in the ED (5)(6). Key among these changes was the implementation of the triage tool, which facilitates the categorization of patients according to their clinical presentation, and differentiates critically ill patients from others (4)(7). Based on the modified South African Triage Score (mSATS) in use in the ED at CHUK (figure 1), patients are categorized according to Triage Early Warming Score (TEWS) and discriminatory signs (Emergency signs, very urgent signs and urgent signs) (4).

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Before TAB 1: 3rd Form (A&E 003)

A&E ADULT TRIAGE (Over 12 Years Old)

PATIENT Identification
ID No: _____
Last Name: _____
First Name: _____
DOB: ___ / ___ / ___ Sex: M F

PATIENT SCREENING:

STOP **all patients at the doorway and screen before the patient enters the A&E Department:**

1. **Does patient have fever now or in past 3 days?** ❑No ❑Yes (if fever now, record below in Vital Signs).
   Call physician to evaluate before proceeding.
2. **Physician screening for positive travel history:** ❑No ❑Yes (if yes, Location: _____ Dates: _____)
   If fever and positive travel history, contact Infection Control and immediately transport patient to Ward 6 using strict Isolation Guidelines.

A & E Arrival Date: ___ / ___ / ___ A & E Arrival Time: __ __ *hr* __ __ *mn*

Chief Complaint: **Patient Weight:** _____ kg

Circle Triage Color:

1 EMERGENCY SIGNS *Evaluate for:*

Airway & Breathing	❑Not Breathing ❑Obstructed Breathing ❑Severe Respiratory Distress ❑Oxygen saturation less than 92%
Circulation	❑Cardiac Arrest ❑Hemorrhage- uncontrolled ❑Stabbing/gunshot/penetrating injury to neck or chest
Convulsions	❑Current convulsion/seizure or postictal (patient not alert) *Glucose* = ___
Coma	❑Unresponsive or responsive to pain only *Glucose* = ___
Other	❑Hypoglycemia (glucose less than 3 mmol/L or 60mg/dL) ❑Purpuric Rash ❑Burn to face, or inhalation burn

YES ☑ → **RED** Immediate Resuscitation Alarm

No ↓

2 VITAL SIGNS

HR	BP /	Temp° C	RR	O_2 Sat %	Pain /10

3 TRIAGE EARLY WARNING SCORE (TEWS) *Total the score:*

	3	2	1	0	1	2	3	SCORE
Mobility				Walking	Wheelchair	Stretcher		
RR		<9		9→14	15→20	22→29	>29	
HR		<41	41→50	51→100	101→110	111→129	>129	
SBP	<71	71→80	81→100	101→199		>199		
Temp		Cold <35.0		35.0→38.4		Hot >38.4		
AVPU		Confused		A	V	P	U	
Trauma				No	Yes			
							TOTAL:	

Saturation <92% → **RED** Immediate Resuscitation

Saturation >92% → Calculate TEWS

7→14 → **RED** Immediate Resuscitation

5→6 → **ORANGE** Less than 10 minutes

0→4 ↓

4 VERY URGENT SIGNS *Evaluate for:*

Medical
- ❑Focal neurologic deficit- acute (less than 1 day *Glucose* = ___
- ❑Altered Mental Status *Glucose* = ___
- ❑Chest pain
- ❑Poisoning/overdose
- ❑Pregnant + abdominal pain
- ❑Coughing or vomiting blood
- ❑Unwell with diabetes, glucose >11mmol/L *or* >200mg/dL *Glucose* = ___
- ❑Aggression
- ❑Shortness of breath- acute (less than1 day)

Trauma
- ❑Burn over 20% of body, or urgent signs (electrical, chemical, or circumferential)
- ❑Fracture- open (with skin break)
- ❑Threatened limb (no pulse or pale)
- ❑Eye injury
- ❑Dislocation of larger joint (not finger or toe)
- ❑Severe mechanism of injury (fall > 1meter, RTA, other significant trauma)
- ❑Pregnant + abdominal trauma
- ❑Severe pain (>7 out of 10)

YES ☑ → **YELLOW** Less than 60 minutes

NO & 3→4 → **YELLOW** Less than 60 minutes

NO & 0→2 ↓

5 URGENT SIGNS *Evaluate for:*

- ❑Unable to drink or vomits everything
- ❑Abdominal pain
- ❑Very Pale
- ❑Pregnant + vaginal bleeding
- ❑Diabetic, not unwell but glucose >300mg/dL *or* 17mmol/L *Glucose* = ___
- ❑Burn without urgent signs
- ❑Fracture, closed
- ❑Dislocation of finger or toe
- ❑Pregnant + trauma (not abdominal)
- ❑Moderate pain (5 to 6 out of 10)

YES ☑ → **GREEN** Less than 4 hrs Reassess every hour

NO → **GREEN** Less than 4 hrs Reassess every hour

Triage Nurse Triage finish time: __ __ *hrs* __ __ *mn* **Nurse Full Name:** _____ **Signature:** ___

If RED or ORANGE **Physical notified @** __ __ *hrs* __ __ *mn* **Name:** _____ **Attended @** __ __ *hrs* __ __ *mn*

Therefore:

- Red patients are critically ill necessitating quick resuscitation and immediate critical care management. They are divided into two subgroups: ‘Red with alarm’ and ‘Red without alarm’. The 'with alarm' category depends on the presence of specific emergency signs, in addition to the standard TEWS physiology score (figure 1).
- Orange patients are those potentially unstable. They might require critical management.
- Yellow patients are stable.
- Green patients have minor injury and illness (the most stable patients).

2.3. Empirical Literature

The ED Length of Stay (EDLOS) is defined as the time from the triage in ED up to the transfer to inhospital ward or discharge from ED, and hospital length of stay (LOS) was defined as the time from hospital admission to patient discharge (8)(9). Accepted EDLOS is, in general, six hours duration of a patient in ED. However in the United Kingdom, The National Health Service of the uses a four hour target (10).

As a critical indicator of quality of care for hospitals, ED Boarding time (EDB) is defined as the time between the admission decision by inpatient team an departure from the ED (9). Lord et al. define EDB time as more than four hours that each patient passes in ED in transition care from the ED team to the inpatient general medical team (11). In addition, in 2021, Nouri et al. defined EDB as the inability to transfer the admitted ED patient to downstream ward within 2h (8). EDB is the primary reason for ED crowding.

Shortage of ICU beds is a growing global challenge(9). The need of critical care beds is rising out of proportion to bed availability, deriving from an aging population and an increase of complex of medical diseases (9). Therefore, some severely sick patients are held in the ED while waiting for bed availability. EDB is frequent and increasing worldwide, resulting in extended LOS (9). The

wait time for ICU admission can vary from two hours to few days, deferring between hospitals and nations (9). EDB may have significant consequences which can lead to delay in time-sensitive interventions (12) (9).

One study found that ICU patients treated during peak demand periods had almost a twofold increase in risk of mortality (12). Although EDB results to decreased quality of care to all patients, critically ill patients remain particularly vulnerable. Research has found an significant association between ventilator-associated pneumonia and ICU mortality (4) (8) (9).

Therefore, critical interventions are provided. A study done in Canada by Green and Macyntyre, revealed that critically ill patient management in the ED occurred at a crucial phase of care, when intervention can considerably have positive impact on outcome and survival (13). They showed that among critical patients admitted in ICU from ED, most of invasive procedures were performed in ED and many ICU admissions received at least one invasive procedure in ED, such as endotracheal intubation, central venous access, arterial catheter insertion, and chest tube insertion at respectively 64%, 17.9%, 14.1% and 4.5% (13).

Increased mortality has been suggested to be associated with awaited ICU bed availability.
In Brazil a study found a median of 17.8 hours for delayed ICU admission among examined patients(14). In this study, patients were managed by ward staff while waiting for an ICU bed and 1.5% increased risk of ICU death for each hour delay was associated with the delayed admission to ICU(14). In United States, a multicenter study analyzed a database greater than 50,000 patients from approximately 120 different ICUs and found that there was an association between the increased hospital LOS and high ICU and hospital mortality with the delayed admission greater than six hours (15). Another Australian study done by Parkhe and his colleagues, found that patients admitted to ICU within 24 hours of ward admission from ED had a significant increase in 30 day mortality compared with patients admitted to ICU directly from ED (16). Young MP et al. did a study in an hospital in Utah (United States of America) which demonstrated an association between increased mortality and delayed transfer to ICU over four hours (17). Simchen and his colleagues revealed an improved early survival for ICU patients compared with patients treated in regular departments (18)**.** This almost equates to the effects of subsequent ICU care for the first 72

hours of hospitalization. This is coherent with the long-standing premise that there is a ‘‘golden hour and silver day’’ in the continuum of care in critically ill patients, which suggests that reversibility of disease and mortality may be greatest in the initial hours of presentation (19).

On the other hand, a United Kingdom study found that in ICU patients with EDB over than 3 hours had similar ICU LOS and mortality rates compared to those with shorter EDB (20). Furthermore, a study done in Finland demonstrated that there was no association between that such delay with the hospital outcomes or quality of life (21) . A US study revealed that EDB over 24 hours was not associated with hospital mortality during COVID-19 outbreak (12).

2.4. Critical Review and Research Gap identification

Most of previous literatures reviewed has focused on management, ED crowding, and mortality while one researcher did a study in our settings focused on triage category and associated to mortality but did not consider others factors affecting patient mortality including but not limited to; EDLOS, EDB and provided critical management.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This chapter will give an explanation on the methodology employed in this study on epidemiology and outcomes in ED at CHUK.

3.2. Research design

This is an observational prospective cohort study looking at epidemiology and outcomes of critical ill patients in ED at CHUK from April to June 2022.

3.3. Research approach

The present study used quantitative approach and analyzed collected data from participants.

3.4. Research setting

The study site is CHUK, Rwanda's main referral and teaching hospital. Data were collected among very sick patients in the ED.

3.5. Population

The total number of patients admitted to the ED was the population study, of whom critically ill patients were recruited to participate in this study.

Inclusion Criteria

All category Red and Orange adult patients received in CHUK ED during the study period, and consented for the study.

Exclusion Criteria

- Stable patients (triage category Yellow or Green)
- Patients less than 15 years old

3.6. Sampling

3.6.1. Sample size

Sample size calculation for estimating a single mean was performed. In a previously published study of trauma patients in CHUK ED (22), the standard deviation of ED length of stay for those admitted was approximately 2 days. With a confidence level of 95%, 249 patients were required to give 95% confidence intervals of +/- 0.25 days for the average length of stay. To allow for those lost following up, we aimed to recruit 320 patients. Calculation was performed using the software statistical calculator: https://statulator.com/SampleSize/ss1M.html

3.6.2. Sampling strategy

A convenience sample of critically ill patients admitted to the ED during the study period was selected. Eligible patients (or their caretaker) signed a consent form before being enrolled in the study and the recruitment continued until the total sample size was reached.

3.7. Data Collection

Data was collected from the patient's medical records by the primary investigator then helped by the other residents and nurses working in the ED. A structured questionnaire was used for data collection. Data was collected from the triage tool and the patient's medical records and examined. Outcomes were categorized according to triage category and characteristics, within time spent in emergency department. Each patient's hospital registration number was used instead of their name. The primary investigator also generated a study code to identify each participant.

3.8. Data analysis

Data were analyzed using Epi Info software. Descriptive statistics including frequencies and percentage were generated for the rates of critically ill patients and types of critical management provided for those patients. Variables such as the ED length of stay, boarding time and disposition were measured based on critical ED interventions delivered. The primary outcome was ED mortality. In addition, inferential statistical analysis was performed to establish the relationship between independent and outcome variables. This was done using Chi-square test at 95% confidence interval where P-value of 0.05 was considered statistically significant.

3.9. Ethical considerations

Confidentiality

The questionnaires were locked in a well-protected cupboard accessed only by the principal investigator.

Ethical Approval

We obtained ethical approval from the University IRB committee (No 178/CMHS IRB/2022) and KUTH research committee (EC/CHUK/044/2022) before starting data collection.

3.10. Data management

3.11. Data Dissemination

The study finding will be submitted to a peer reviewed journal for publication after being presented as a thesis of the Master of medicine in Emergency medicine and critical care.

3.12. Limitations and challenges

The limitations and challenges found will be analyzed in the discussion.

CHAPTER FOUR: RESULTS

4.1 Socio-Demographic characteristics

The distribution of social-demographic characteristics of patients who participated in the study is presented in Table 1**.** A total of 320 patients aged at least 15 years old at CHUK ED were recruited. The median age was 40 years (range 15 to 93), and 66.9% were male. 41.3% had self-attended, 41.3% had been transferred from District Hospitals, and 17.2% had been brought by SAMU (Services d'Aide Medicale Urgente).

Table 1 Socio-Demographic of Patients

Variables	**N = 320**	**%**
Sex		
Male	214	66.9%
Female	106	30.0%
Age		
Age (years); median (range)	40	(15 - 93)
Arrival to ED		
Self-attended	133	41.3%
Transfer from District Hospital	132	41.3%
Brought by SAMU	55	17.2%

4.2 Triage category and causes of critical illness

The majority (65.3%) of patients were categorized as orange, 22.8% were categorized in red without alarm and 11.9% were red with alarm, as illustrated in Table 2. 47.2% attended due to non-trauma medical issues, 44.1% attended due to trauma and 7.5% attended due to non-trauma surgical complaints.

Table 2 Triage category and causes of critical illness

Variables	N = 320	%
Triage Category		
Orange	209	65.3%
Red without alarm	73	22.8%
Red with alarm	38	11.9%
Cause		
Trauma	141	44.1%
Non-trauma (Medical)	151	47.2%
Non-trauma (Surgical)	24	7.5%

4.3 ED Critical Care Provided

Of the critically ill ED patients in this study, 8.8% were intubated and mechanically ventilated. 0.9% patients received non-invasive ventilation. Vasopressors or inotropes were used in 3.1%, and chest tube insertion was performed in 3.0%. 10.3% patients underwent CPR during their ED stay. Pericardiocentesis was performed in 1.3% patients and thoracocentesis in 2.8%.

Table 3 ED critical care provided

Variables	N = 320	%
Intubation	28	8.8%
Non-invasive ventilation	3	0.9%
Central venous access	6	1.9%
Vasopressor	10	3.1%
Tube thoracostomy	9	2.8%
CPR	33	10.3%
Pericardiocentesis	4	1.3%
Thoracentesis	9	2.8%

4.4 Patient Outcomes

Median length of stay was 33.5 hours (range 0.5 and 809.5). Median boarding time was 22.2 hours (range 0.47 - 452.2). 0.3% of critically ill patients were admitted to the High Dependency Unit (HDU), 2.8 to ICU, and 7.8% to the Operating Theatre. 47.2% patients were admitted to general wards. Mortality rate was 12.2% and 0.9% transferred to another hospital.

Table 4 Patients outcomes

Variables	**N = 320**	**%**
Length of Stay (Hours)		
Median (range)	35.5 (0.5 – 809.5)	
Duration of boarding (Hours)		
Median (range)	22.2(0.47 – 452.2)	
Outcomes		
Discharge home	92	28.8%
Admission to ward	151	47.2%
Admission to ICU	9	2.8%
Admission to Operating Theatre	25	7.8%
Admission to HDU	1	0.3%
Transfer to another hospital	3	0.9%
Death	39	12.2%

4.5 Association between boarding time, length of stay and mortality

Table 5 shows that after 12 hours, mortality rises highly with EDLOS and EDB for admitted patients at respectively 75% and 70.8%. Mortality was significantly associated with EDLOS where more than 75% of patient died within more than 12 hours with P-Value 0.024. While for EDB, there was no statistical association with mortality rate among ED critically ill patients.

Table 5 Association between Boarding time, length of stay and mortality

	Mortality		
Variables	**Admitted**	**Non admitted**	**P-value**
ED boarding time			
<12Hours	8(53.3%)	7(46.7%)	0.268
>12Hours	17(70.8%)	7(29.2%)	
ED Los			
<12Hours	4(36.4%)	7(63.6%)	**0.024**
>12Hours	21(75.0%)	7(25.0%)	

*Mortality was defined as patients who died in the emergency department during the two-month study period, according to medical records

4.6 Association Between Outcomes and Critical Care Provided in the ED

Table 6 shows that intubation, vasopressor/inotrope use and CPR were strongly associated with mortality (p-value <0.001). There was no statistically significant association between mortality and any other ED critical care provision. Based on then triage category, Red with alarm has high mortality rate (46.1%) in the total number of deceased, followed by Red without alarm and Orange with respectively 30.8% and 23.1% with significant association between triage category and mortality (p-value=0.001). There was no statistically significant association between mortality and any other factors.

Table 6 Characteristics associated with mortality outcome

Characteristics associated with mortality outcome % (n)			
	Survived (n=281)	**Deceased(n=39)**	**p-value**
Sex			
Female	33.5 (94)	30.8 (12)	0.7387
Male	66.6 (187)	69.2 (27)	
Arrival to ED			
Self-attended	43.8 (123)	25.6 (10)	0.0743
Transfer from District Hospital	38.2 (110)	56.4 (22)	
Brought by SAMU	17.1 (48)	18.0 (7)	
Cause			
Trauma	47.1 (131)	26.3 (10)	0.0455
Non-trauma (Medical)	45.3 (126)	65.8 (26)	
Non-trauma (Surgical)	7.6 (21)	7.9 (3)	
Interventions			
Intubation	3.2 (9)	48.7 (19)	<0.0001
Non-invasive ventilation	0.7 (2)	2.6 (1)	0.2607
Central venous access	1.8 (5)	2.6 (1)	0.7349
Vasopressor	1.4 (4)	15.4 (10)	<0.0001
Tube thoracostomy	2.1 (6)	7.7 (3)	0.0492
CPR	1.1 (3)	76.9 (30)	<0.0001
Pericardiocentesis	1.4 (4)	0.0 (0)	0.4534
Thoracentesis	2.5 (7)	5.1 (2)	0.3506
Triage color			
Red with alarm	7.1 (20)	46.1 (18)	0.0001
Red without alarm	21.7(61)	30.8 (12)	
Orange	71.2(200)	23.1 (9)	

CHAPTER FIVE: DISCUSSION

EDB time and EDLOS in the hospital are vital indicators of health services that are used to evaluate the efficacy of patients care, and have been documented to improve the survival of adults critically ill patients from high resource countries. In this study, 320 patients were enrolled. The median age was 40 years, the majority were male (66.9%). 41.3% self attended the hospital in the similar proportion with those transferred from district hospital (41.3%) and 17.2% had been brought by SAMU (Table1). This was similar to the study done by Nouri et al, in which 1608 patients who were referred to the ED included 941 (58.5%) males and 667 (41.5%) females. The mean age (years) of male and female patients was 41.39 ± 0.76 and 46.06 ± 0.89, respectively (23). The socio-demographic distribution of this study was also similar to another study by Tang et al at CHUK ED in 2021 in regard to mean age (1).

Our findings demonstrate an increased mortality based on the severity of the triage category, which is similar to results found on outcomes of critically ill patients from Rwanda, Haiti, and Afghanistan (4)(7).

According to Boudi et al, possible reasons for association between boarding time and risk of hospital mortality include healthcare providers in the ED who are not trained in critical care medicine, delay in time-sensitive treatment, limited expertise of ED staff when compared to ICU providers of critical care, as well as the fast-paced nature of emergency departments that leads to limited one-on-one care required for critically sick patients (9). Such reasoning from Boudi et al are applicable to our study setting but our findings demonstrated a relationship between prolonged EDLOS and high mortality rate despite provided critical management, not EDB contrarily to Boudi et al study (9). Similarly, research has found a prolonged EDLOS in Ethiopia are due to a shortage of beds in inpatient wards, especially in the ICU, due to overcrowding, shortage of laboratory test availability, and delay in imaging services which are very common in the ED settings in LMIC such as ours, impacting in the mortality rate (23).

In addition, similarly to our findings, Zhang et al. showed also that prolonged EDLOS is associated with increased risk of mortality (24). The median EDB and patient outcomes found in this study are similar to results from O'Callaghan et al, which demonstrated that the duration of boarding due to unavailable ICU beds is not associated to mortality (18).

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study highlights the need for urgent measures to be taken to reduce EDLOS and to improve patient flow.

Several limitations are found in our study. Primarily, data was analyzed from a single study site. In the future, this study can be extended to other tertiary hospital across the country, which would show factors influencing the outcomes of critically ill patients countrywide. Secondly, given the observational nature of the study, some potentially impactful predictors of outcome could not be accessed (e.g. prognosis of the severely sick patients upon presentation to the ED, patient's disease at condition and disease at arrival in ED). Thirdly, selection bias of triage category may have influenced results.

As ICU or HDU bed need keeps rising, EDLOS will continue to rise which, according to studies and our findings has an impact in mortality rate despite critical management provided, unless an increase of ICU beds meets patient demand. Though, early transfer to ICU and/or inward is beneficial for critically ill patients, mainly focused on the timely intervention and organ support.

6.2 Recommendations

1. Further research should be done to explore the same variables related to the patient categories as triage standardized at different settings including but not limited to emergency departments, may be by using a different methodology.

3. Need of trained Critical care or Emergency nurses in ED.

4. The hospital should advocate for the extension for the ICU/HDU unit.

5. Departmental awareness for decreasing the EDLOS.

6. A hospital-wide quality improvement project aiming at looking at a maximum time EDB, EDLOS and inhospital LOS, which should be regularly monitored and provide guideline to be implemented and followed.

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APPENDICES

1 Authorization letter (s)

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 9th /March /2022

Dr Laurent GAMMY Kamunga
School of Medicine and Pharmacy, CMHS, UR

Approval Notice: No 178/CMHS IRB/2022

Your Project Title ***"Epidemiology and Outcomes of Critically Ill Patients in Emergency Department at Kigali University Teaching Hospital"*** has been evaluated by CMHS Institutional Review Board.

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

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 7th March 2022, **Approval has been granted to your study.**
Please note that approval of the protocol and consent form is valid for **12 months**.

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

You are responsible for fulfilling the following requirements:

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

Sincerely,

Date of Approval: The 9th March 2022

Expiration date: The 9th March 2023

Assoc. Prof Stefan Jansen
Ag. 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

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Ethics Committee / Comité d'éthique

28th Mar,2022 Ref.:EC/CHUK/044/2022

Review Approval Notice

Dear KAMUNGA BADIBANGA Laurent Gamy ,

*Your research project: "**Epidemiology and outcomes of critically ill patients in emergency department at Kigali university teaching hospital** "*

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 28th Mar,2022 to evaluate your request for ethical approval of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your research project.

You are required to present the results of your study to CHUK Ethics Committee before publication by using this link:www.chuk.rw/research/fullreport/?appid=558&&chuk.

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

Yours sincerely,

Dr Emmanuel Rusingiza Kamanzi
The Chairperson, Ethics Committee,
University Teaching Hospital of Kigali

ETHICS COMMITTEE
CHUK

Scan code to verify.

" 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 "

2 Research instruments

QUESTIONNAIRE

TOPIC: EPIDEMIOLOGY AND OUTCOMES OF CRITICALLY ILL PATIENTS IN EMERGENCY DEPARTMENT AT KIGALI UNIVERSITY TEACHING HOSPITAL.

PARTICIPANT STUDY CODE:

I. SECTIONI: DEMOGRAPHIC DATA

Come in (Triage time): Date: ...../...../..... Time: .....h.....min

- CHUK ID number: .....
- Gender: - Male ☐ -Female ☐ Age: (or DoB).....
- Triage category: - Red with alarm ☐ Red without alarm ☐
  - Orange ☐

ORIGIN: Self-attended ☐ Brought by SAMU ☐ Transfer from DH ☐

CAUSES: Traumatism ☐

Non-traumatism: Surgical ☐ Medical ☐

II. SECTION: MANAGEMENT

- Intubation and mechanical ventilation ☐ Non Invasive ventilation ☐
- Central line insertion ☐
- Vasopressor (inotrope) ☐
- Chest tube insertion ☐
- CPR ☐
- Pericardiocentesis ☐
- Paracentesis ☐
- Thoracocentesis ☐
- Other ☐

III. SECTION: OUTCOMES IN ED

Disposition: Discharge home ☐

Transfer to another hospital or counter-refer ☐

Admission note: Date...../...../..... Time:.....H.....Min

Length of Stay In ED: Come out (move from ED): Date ...../...../..... Time: .....h.....min

Admission (move to): Theater ☐ Intensive care unit (ICU) ☐ HDU ☐

Ward ☐ Death ☐

INFORMATION SHEET AND CONSENT FORM for the study entitled "**Epidemiology and outcomes of critically patients in Emergency department at Kigali University Teaching Hospital**"

"Kwiga ku ndwara z'ibyorezo n'uburyo zivurwa ku barwayi barembye cyane mu ishami aho bavurira inkomere n'indembe mu bitaro bya kaminuza i Kigali""

AMAKURU N'ICYEMEZO CYO KUGIRA URUHARE MU BUSHAKASHATSI

Researcher identification:
Umwirondoro w' umushakashatsi:
KAMUNGA B. Laurent Gamy, MD, Resident in Emergency medicine and critical care at the University of Rwanda.
KAMUNGA B. Laurent Gamy, Umuganga uri kwiga ubuvuzi bwihutirwa n'ubwitonderwa muri Kaminoza y'u Rwanda

Purpose of the Research project:
Impamvu y'ubushakashatsi:

The aim of the study is to know the epidemiology and the outcomes of critically ill patients in Emergency Department at Kigali University Teaching Hospital.

Intego y'ubu bushakashatsi ni ukumenya indwara z'ibyorezo n'uburyo zivurwa ku barwayi barembye cyane mu ishami aho bavurira inkomere n'indembe muri bitaro bya kaminuza i Kigali.

How long will I take part of this research?
Igihe ubushakashatsi buzamara:

The study will take around 3 months.
Ubushakashatsi buzamara amezi 3.

Benefits, Risk or Discomfort:
Ibyago n'imyungu zo kuba muri ubu bushakashatsi:

There will be no direct benefit to study participants. But the result of this study will be used forfurther improvement of health care delivery. There will be no risk of participating in this study.

Nta nyungu z'ako kanya uzabona muri ubu bushakashatsi, ariko amakuru y'ubu bushakashatsi azakoreshwa mu kunoza serivisi duha abarwayi. Nta byago duteganya igihe waba uri muri ubu bushakashatsi.

Participation is voluntary
Kwitabira ni ku bushake

Confidentiality:
Ibanga

The information collected from the study subjects will be kept confidential and by assigning a code number to each patient, the name of the patient will not be recorded or used in any report.

Amakuru yose utanga muri ubu bushakashatsi azagirwa ibanga. Ayo makuru azahabwa inumero y'ibanga. Nta hantu na hamwe amazina y'umurwayi azakoreshwa.

Right to refusal or withdraw
Igihe wahagarikira uruhare rwawe muri ubu bushakashatsi:

Study subjects will have full right to refuse from participating in this research without penalty.

Ushobora guhagarika uruhare rwawe muri ubu bushakashatsi igihe icyo aricyo cyose kandi ntubiryozwe.

Persons to contact
For any questions or concerns you can contact the principal investigator or senior mentor using the following addresses:

Niba ufite ibibazo bijyanye n'ubu bushakashatsi, binyuze kuri aba bakurikira:

Name: Dr KAMUNGA B. Laurent Gamy
Phone: 0787884992
E-mail:gamykamunga@gmail.com

Name: Dr UWAMAHORO Doris Lorette
Phone: 0788529480
E-mail:ulorette@gmail.com

STUDY SUBJECTS CONSENT FORM
Kwemera kugira uruhare mu bushakashatsi

As a patient (or caretaker), I agree to take part in this study described above.

Nk'umurwayi, ndemera kugira uruhare muri ubu bushakashatsi nasobanuriwe.

Patient Signature:_____**Date:**_____
Umukono w'umurwayi:_____ ***Itariki:***