COLLEGE OF MEDICINE & HEALTH SCIENCES

SCHOOL OF MEDICINE & PHARMACY

DEPARTMENT OF SURGERY

ASSOCIATION BETWEEN LACK OF INTENSIVE CARE UNIT (ICU) ACCESS AND MORTALITY IN PATIENTS WITH COMBINED ASSESSMENT OF RISK ENCOUNTERED IN SURGERY (CARES) MORE THAN 20 POINTS AT CHUB AND CHUK: A COHORT STUDY

Thesis submitted in part to fulfill the requirements for conferring a master's degree of Medicine in General Surgery at the University of Rwanda.

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Submission done at Kigali on 31st August 2021

DECLARATION

The Researcher:

I hereby declare that this dissertation **"*ASSOCIATION BETWEEN LACK OF INTENSIVE CARE UNIT (ICU) ACCESS AND MORTALITY IN PATIENTS WITH COMBINED ASSESSMENT OF RISK ENCOUNTERED IN SURGERY (CARES) MORE THAN 20 POINTS AT CHUB AND CHUK: A COHORT STUDY*** "This is my own work and has not been submitted to any other university for a degree by anyone."

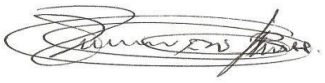
Signed: 

Date: 28 August 2021

Dr Emmanuel Manirabona

The Supervisors:

I hereby declare that this dissertation: **"*ASSOCIATION BETWEEN LACK OF INTENSIVE CARE UNIT (ICU) ACCESS AND MORTALITY IN PATIENTS WITH COMBINED ASSESSMENT OF RISK ENCOUNTERED IN SURGERY (CARES) MORE THAN 20 POINTS AT CHUB AND CHUK: A COHORT STUDY*"** was submitted by Dr Emmanuel Manirabona with my approval.

Signed: 

Date: 29 August 2021

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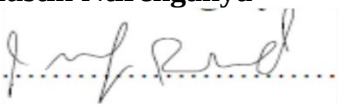
Signed: 

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Prof. Jennifer Rickard

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Emmanuel Manirabona, MD

DEDICATION

First of all, I thank the Lord Almighty, for his Divine Mercy…He swept me up countless times and kept carrying me on his Holy shoulders whenever I stumbled.

I dedicate this work to my dear family that was always by my side even when I was far away physically. My brothers and sisters, who kept cheering me on and brought so much joy to my heart. My parents, Patricia Mukamusoni and Augustin Nzabamwita, whose Faith and Love kept me from straying from the right path. My beloved parents gave me everything from my name to my passion. They and will always stay my first Mentors.

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Finally, I dedicate this work to the one and only, who stood firmly even during the storm, who endured all my trials in silence with a smile, who comforted me and believed in me until the very end: Nisingizwe Denyse, the love of my life.

Be blessed.

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LIST OF ABREVIATIONS

CHUK: Kigali University Teaching Hospital

CHUB: Butare University Teaching Hospital

KFH: King Faisal Hospital

KRH: Kibungo Referral Hospital

CMHS: College of Medecine and Health Sciences

ACS: Acute Care Surgery

ICU: Intensive Care Unit

PACU: Post Anesthetic Care Unit

CARES: Combined Assessment of Risk Encountered in Surgery

ASA: American Society of Anesthesiologist

RDW: Red blood cell redistribution width

qSOFA: Quick Sequential Organ Failure Organ Failure Assessment

IRB: Institutional Review Board

KRH: Kibungo Referral Hospital

RSS: Rwanda Surgical Society

UR: University of Rwanda

LMIC: Low- and Middle-Income Countries

ERAS: Enhanced Recovery after Surgery

SCIU: Surgical Intensive Care Unit

USA: United States of America

SCCM: Society of Critical Care Medicine

ESS: Emergency Surgical Score

SAS: Surgical Apgar Score

POSSUM: Physiology and Operative Severity Score Count of Mortality and Morbidity

GIT: Gatro-Intestinal Tract

LOHS: Hospital Length of Stay

PLOHS: Prolonged length of Hospital Stay

WHO: World Health Organization

ABSTRACT

Background

Lack of access to intensive care unit (ICU) for both surgical and non-surgical patients is common in countries with limited resources. In the current literature, there is a paucity of published data on the outcome of patients who lacked access to ICU while they were having criteria for critical management after surgery. The aim of this study was to assess the mortality and length of hospital stay for patients with a combined assessment of risk encountered in surgery (CARES) >20 points who had surgery and lacked access to ICU in comparison to those who got admission to ICU

Methods

This was a prospective comparative cohort study carried out in two university teaching hospitals which are Butare University Teaching Hospital(CHUB) and Kigali University Teaching Hospital (CHUK) over 10 months' period, from June 2020 to April 2021. All participants were followed in-hospital till discharge, death or till 30 days postop whichever came first. Mortality and length of in-hospital stay were recorded and compared in ICU access and non -ICU access groups.

Data analysis was done using SPSS version 25.0 (IBM Corporation, New York 10504-1722, USA). Percentages and means were used for descriptive statistics. For categorical variables with comparison groups, chi-square test was used. For continuous variables, t-test and ANOVA test were used to compare means among groups. A p–value of 0.05 or less was considered statistically significant. Odds ratio (OR) and 95% confidence interval (CI) were estimated using logistic regression analysis.

Results:

In total 708 acute care surgery (ACS) patients were evaluated using CARES surgical risk calculator and 213 patients had CARES> 20 points and were enrolled in the study. 82 patients had post-operative ICU access timely or delayed while 130 did not have access to critical care service after operation and 1 patient has died intraoperatively.

Mortality rate among patients who had immediate post-operative ICU admission was 26.4% versus 89.7% for those who had delayed admission and 48.1% in no ICU access group. Delayed ICU admission increases mortality by 24-fold (95% CI, 6.304-92.393, p-value <0.001) while lack of ICU access or post-operative surgical ward admission resulted in 3-fold increased risk of death (95%CI, 1.281-5.199, p-value <0.001)

The hospital-stay for patients who had timely ICU admission was 13.7 days versus 16.5 days for no access to ICU group and 7.1 days in patients who had delayed ICU access (p-value <0.001). Preoperative inotropes need (p value=0.003), intraoperative hypotension and requirement of inotropes (p-value <0.001), American Society of Anesthesiologists (ASA) status III and above (p-value <0.001), acute kidney injury (AKI) (p-value <0.001), quick sequential organ failure (qSOFA) score ≥ 2 (p-value <0.001) and lack of life insurance (p-value = 0.004), were identified as factors influencing mortality.

Conclusion:

There was a strong association between mortality, increased length of hospital stay and lack or delayed post-operative ICU access in ACS patients with CARES> 20 points. Early management, preoperative ICU bed booking and timely ICU admission may considerably decrease mortality and morbidity. We recommend to increase ICU capacity for both CHUB and CHUK, improve pre-operative evaluation of all surgical emergencies and create a dedicated area for suitable monitoring and management for critically ill surgical patients when access to ICU is limited or unavailable.

Keywords: *ACS patients, intensive care unit, CARES risk calculator, Mortality, Length of hospital stay*

CHAPTER I. INTRODUCTION

I.1 Background

Rwanda like other low- and middle-income countries (LMICs) have limited intensive care unit (ICU) facilities, making access to critical care management challenging for both surgical and non-surgical patients.(1) In developed countries, there is in average 20-30 ICU beds per 100, 000 population while in developing countries, it is estimated to be between 0.1 - 0.5 ICU beds per 100,000 populations.(2) However, accurate data on the subject are missing especially in sub-Saharan Africa.(3)(4) According to the estimation of critical care capacity in 54 African countries in 2020 from local and/or international news, "Rwanda has a total of 50 ICU beds and 46 ventilator machines which makes approximately 0.4 ICU beds per 100,000 populations".(5)

ICU admission refusal as well as late admissions due to full unit or beds shortage impact negatively patients' outcome.(6)(7) Delayed post-operative ICU admission, (defined as waiting more than 6 hours the availability of ICU bed) for a patient fulfilling criteria for critical management, it was shown to be related to an increase in mortality and morbidity compared to early admission.(8)(9) Each hour a patient spends waiting for a place in critical care service independently increases risk of mortality by 1.5%.(10) Indeed, the majority of publications highlight a high mortality rate and a long hospital stay for critically ill patients managed in regular surgical wards following lack of ICU bed. For that reason, investing in increasing ICU capacity should not be seen as luxury in settings with limited resources.(11)(12)

Acute Care Surgery (ACS) englobes a triad of trauma, surgical critical care and emergency general surgery. This triumvirate of practice provides management to critically ill surgical patients in extremely important time of their conditions. Implementation of ACS model has contributed positively to the outcome of surgical patients, as it gives a continuous coverage of surgical emergencies in timely fashion.(13) ACS service was started at University Teaching Hospital of Kigali (CHUK) in 2013 and later at CHUB in 2015. It takes care of adult surgical patients who consult through emergency departments of both University Teaching Hospitals CHUK and CHUB including trauma and non-trauma general surgery emergencies, and obstetrics and gynecology surgical consults.(14)

Improved outcomes for surgically managed ACS patients can be achieved through a good preoperative assessment and planning. Identification of high-risk non-cardiac surgical patients can easily be done by use Surgical risk calculator for comprehensive risk assessment found

during surgery.(15) CARES was developed in Southeast Asia and it is composed of nine preoperative variables to predict 30 days mortality and need of critical care management after non-cardiac and non-neurological operations.(15) A patient who has between 0-10 points is safely operated, 11-20 points patient requires identification of modifiable risks before proceeding to surgery while those patients with more 20 points need critical care management for smooth recovery after completion of surgery to improve survival.(15)

The aim of this study was to evaluate the impact of lack or delayed post-operative ICU access about mortality and length of hospital stay on patients from ACS who have consulted emergency department units of two Rwanda referral teaching hospitals, CHUB and CHUK, with CARES points more than 20.

I.2 Problem statement

In Rwanda, access to ICU is limited. In fact, critical care services are offered almost exclusively at tertiary level hospitals. These include the two university teaching hospitals of the country (CHUB and CHUK). Receiving up to 75% of all surgical and medical referrals of the country, these two hospitals have a combined ICU capacity of 17 beds, with 10 beds in CHUK and 7 beds in CHUB shared between medical and surgical patients.

For surgical patients, when a surgeon anticipates that a patient may need ICU admission, the common practice is to book an ICU bed before surgery. However, the ICU is commonly full hindering decision making for ACS patients who often need intensive care services. A recent study conducted at CHUK about factors affecting the mortality in surgical patients admitted in intensive care has revealed the overall mortality is reaching 46%. Higher mortality rate was seen in peritonitis patients (60%) and polytrauma patients (100%)(16). The outcome of those who had no access to ICU when needed is not documented. However, an internal audit for patients who lacked access to ICU after undergoing surgical operation with criteria for critical management and remained intubated in PACU at CHUK found 63% mortality.

The admission of surgical patients to critical care end up with good results including lower mortality rate, reduced time on mechanical ventilation and length of stay in the intensive care unit compared to medical patients. Still, access to ICU for surgical patients after operation is still a big challenge in LMICs including majority of African countries.(17) Indeed, morbidity and mortality in perioperative patients remain high in low-income countries where previous

researches have proved that one hour delay may increase mortality by 1.5%.(18) For that reason , early management, preoperative ICU bed booking and timely ICU admission may considerably decrease mortality and morbidity.(19)(20)

I.3 Study Justification

Previous studies conducted in the United States and Europe, have shown that delayed critical care admission contributes to increased mortality and prolonged hospitalization for either medical and surgical patients. However, there is no universal tool to identify surgical patients who require ICU management.(6)(8)

Timely triage of high-risk surgical patients for ICU admission continues to be a challenge among surgeons and anesthesiologists. The current practice relies on deciding ICU admission after completing a surgical procedure, when the patient is judged not fit to recover in a surgical ward.(21) However a better practice would be preoperative identification of patients who will require ICU care (21)

To our knowledge, there is no study done concerning association between lack of ICU access and hospital mortality in surgical patients in Rwanda. We conducted a study to evaluate mortality and length of hospital stay in ACS patients with CARES more than twenty points. The study could help to inform hospital managers and decision makers, improve decision making and planning for post-operative care of emergency non-trauma and trauma patients.

I.4 Research question

How do mortality and length of hospital stay compare in ACS patients with CARES >20 admitted in ICU versus those not admitted?

I.5 Hypothesis

Post-operative lack of ICU access increases mortality and hospital stay in ACS patients with CARES>20 points

I.6 Objectives

I.6.1 General objective

The aim of this study was to assess the impact on mortality and length of stay in hospital for ACS patients with CARES >20points who lacked access to ICU

I.6.2 Specific objectives

1. To describe epidemiological profile of ACS patients with CARES >20 points in CHUB and CHUK
2. To determine prevalence of ACS patients meeting hospital ICU admission criteria in CHUB and CHUK
3. To compare mortality of ACS patients with CARES >20 points who get ICU access after surgery versus those who had a delayed access or no access to ICU
4. To compare length of hospital stay in ACS patients with CARES >20 points who get ICU access after surgery versus those who had a delayed access or no access to ICU

CHAP II. LITERATURE REVIEW

II.1 Introduction

Acute care surgery as unique service deals with injured and non-injured emergency general surgery patients as well as critically ill patients with surgical conditions.(22) It is slowly expanding in tertiary hospitals of some LMICs and its rapid assessment and management has considerably reduced mortality and morbidity of emergency general surgery patients.(22)

Perioperative care which consists of pre-, intra-, and post-operative treatment, is an important manner of continuous evaluation, monitoring and management of surgical patient. Indeed, this ongoing coverage that is headed by a surgeon in collaboration with anesthetic members to ensure the stability of patient's hemodynamics has subsequently led to decrement in morbidity and mortality after surgery.(23)

Surgical ICU aims to provide critical care treatment to severely, unstable or potentially severely ill patients in their perioperative period, who have life-threatening surgical conditions and require meaningful care, ongoing monitoring, and possible emergency interventions.(24) Critical care services have been defined by World Federation of Critical Care and Critical Care Medicine Associations Working Group as organized systems that provide specialized nursing and medical care to critically ill patients that sustain life during acute periods of organ system insufficiency through multiple means of physiologic support and with enhanced monitoring capacity.(25) Undoubtedly, the need for critical care service is something which is increasing in Africa.(26)

ICU service as a young field began almost 70 years ago during The Second Great War and the Copenhagen polio pandemic of 1953. It developed to support patients affected by polio who were dying from respiratory failure, bulbar palsy and pooling of secretions. Fortunately, mortality from the polio epidemic was reduced by the delivery of positive pressure ventilation with manual rubber bag.(27) The pioneer of ICU creation and implementation is a Danish anesthetist Bjorn Ibsen working at Kommunehospitalet located at Copenhagen in 1950s. Since then, it has proliferated from Europe in all cardinal directions of the world.(28)

Bjorn's idea product which is an equipped and staffed critical care service had a considerable evolution from manual delivery of positive pressure ventilation to the use of respiratory machine and electronic and invasive monitoring of patients. Despite that, more innovations in favor to maximize the offered support to more suffering patients with goal to improve still to come.(29)

LMICs had to wait a decade or more to get their own ICU services where countries like Kenya in cooperation with Japan International Cooperation Agency, has established six ICU beds in 1971 at King George Hospital (later changed name to Kenyatta National University).(30)

Globally, the requirement of critical management is exceeding the capacity of institutions. ICU beds are dominated by surgical patients for more than a half of beds worldwide. LMICs account for more 90% of avoidable deaths mostly from trauma-related conditions including ACS patients.(31) A survey conducted in Uganda, one of sub-Sahara African countries has revealed the predominance of post-operative patients in their critical care services. The highest mortality rate observed in comatose adult patients with medical conditions.(32)

II.2 Criteria of intensive care unit admission

Globally, ICU service is a limited source. It should be given to patients who meet criteria of admission and who can benefit from it. Timely identification of critically ill patients who are failing one or more organ system and management in ICUs has shown to improve their outcome.(33) Patients without serious medical or surgical conditions and who are hemodynamically stable with normal vital signs are too well for ICU admission. However, patients who are severely ill and failing multi-organ systems with irreversible illness are too sick to benefit from critical care admission.(34)

Planning for critical care management after surgery is not a straightforward action. It requires a high suspicion rate coupled with preoperative clinical evaluation plus use of severity of illness risks like American Society of Anesthesiologist (ASA) class, age, high-risk surgery and more recently CARES to prevent unplanned post-operative ICU admission.(35)(15) ICU service does not welcome every patient consulting a given hospital. It is appropriate for patients with recoverable conditions who can use close monitoring and invasive treatment that cannot be delivered in the ward. Patients needing up to date respiratory support, fundamental respiratory monitoring and maintenance, circulatory backing, kidney support and neurological monitoring are good candidates for ICU admission. Factors like diagnosis and prognosis, age, illness severity, comorbidities, availability of suitable treatment and anticipated quality of life should be considered during assessment of suitable patients for critical care service admission.(36)

Society of Critical Care Medicine (SCCM) has recommended, when deciding ICU admission, to adhere to institutions' leaders' policies that are developed to satisfy patients' needs according to

their diagnosis. SCCM has also suggested, to optimize ICU resources use, the combination of particular patients' requirements that can be solely handled in ICU place, diagnosis, available clinical expertise, bed availability and prioritization according to the patient's conditions. ICU admission prioritization framework model describes priority 1 category as a patient in need of life support for failing organ, intensive monitoring and therapy only available in ICU and priority 2 category being patients with low chance of survival and who will not undergo cardiopulmonary resuscitation in case of cardiac arrest.(37)

The decision to admit the patient to the critical care service is no doubt one of the most important things a physician does to save the life of a patient. There are three circumstances that influences decision not to admit including 1) patient wishes to turn down critical management, 2) the judgement of no improvement to patient's illness with ICU treatments and 3) unavailable ICU bed.(38) Patient's status in ICU has to be continuously monitored and revised to sort out individuals who no longer require ICU care. The decision to discharge a patient from critical care can rely on two assumptions including, 1) stabilized patient's physiological status that no longer necessitate ICU management and 2) deteriorated patient's physiological status and active interventions stopped.(39)

II.3 Identification of patients requiring post-operative critical care management

ICU admission is not reserved for every admitted patient nor for every operated patient. Surgical patients may need critical care admission in perioperative period for invasive monitoring and organ support to improve their outcome. There are proven independent risk factors to predict the requirement of ICU management after surgery that include age above 55 years, ASA III and above, high-risk surgery, emergency surgery, male gender, increased blood loss and duration of surgery more than two hours.(40)

The recognition of high-risk surgical patients can be done preoperatively, intraoperatively or post-operatively.(41) There are developed scoring systems like ASA score used during preoperative assessment to sort out surgical patients with high risk of death.(41) Patients with ASA IV or more count almost 50% of surgical deaths. Still, some surgical patients may wait intraoperative period to be declared as high risk.(41) Examples are surgical and anesthetic misfortunes like uncontrollable bleeding, accidental bowel perforations, anaphylaxis and

aspirations.(41) Intraoperative scoring tools for illness severity include Mortality and Morbidity Count Physiology and Surgical Severity Score(POSSUM) and Surgical Apgar Score (SAS).(41)

The prediction of critical care management and ICU admission after operation can be done with tools like Emergency Surgery Score (ESS), SAS, and CARES surgical risk calculator . ESS utilizes 23 variables subdivided into demographics, laboratory investigations and comorbidities. It has a capability of more than 90% to estimate the need of post-operative ICU when a patient scores more than 15 out of 29 maximum points and ≥ 7 points are considered as cut off for ICU admission.(42) The SAS ability is to pick out a high-risk surgical patients intraoperatively. It employs three variables (estimate blood loss, mean arterial pressure, and heart rate.) to identify patients who need post-operative recovery in ICU.(43) SAS and ESS both have limitations that are resolved by CARES surgical risk calculator [Table1&Appendix]. The advantage of CARES tool over ESS and SAS include the potential to pinpoint preoperatively a high-risk surgical patient who will need post-operative critical care and use 9 variables from clinical evaluation and routine labs. SAS is an intraoperative tool that does not help for ICU bed booking before surgery. ESS has 23 variables including disseminated cancer that is not easy to investigate in the LMIC settings.(15)(43)(42)

The CARES surgical risk calculator (Table.1.1) is useful to identify preoperatively those surgical patients who are going to be admitted in ICU after operation. CARES accurately predicts post-operative 30-days mortality risk and ICU stay after surgery. It is calculated during preoperative evaluation using 7 clinical variables and 2 laboratory tests. Variables of CARES model include surgery urgency, gender, sex, red blood cell distribution width (RDW), presence of anemia, ASA status, history of ischemic heart disease and congestive heart failure. A patient is categorized as low when the score is between 0 and 10, low-moderate risk once the score is 10-20, moderate to high when points are ranging 21-31 and high for those patients scoring more than 31 points (Appendix). Moderate to high and high risk patients require ICU admission after operation.(15)

Table. 1.1. CARES variables

CARES Variables	Points
1. Emergency surgery	
2. Surgical risk	
3. Age	
4. Sex	
5. RDW	
6. Anemia	
7. ASA Physical status	
8. Ischemic heart disease history	
9. Congestive heart failure history	
Total points	

II.4 Post-operative outcome of acute care surgery (ACS) patients

Since 2000s, the ACS was started in developed countries. LMICs waited until 2010s. In Rwanda, ACS started at tertiary hospital CHUK in 2013. The implementation of ACS in Rwandan referral hospitals has contributed a lot the outcome of emergency surgical patients. It has decreased their length of stay in hospital. It has provided a dedicated team for management and follow up of emergency surgical disease as well as an opportunity for others to exclusively concentrate on elective cases.(14) The impact of ACS in other countries like New Zealand revealed reduction in mortality, shorten the waiting time for surgery and increase surgical management.(44)

Postoperative complications are common in LMICs especially after emergency gastrointestinal (GIT) operations. Vester-Andersen et al. cohort study in Danish population showed a 18.5% mortality in 30 days after emergency laparotomies for GIT conditions. The study also revealed factor like failure to allocate a high risk surgical patient to a suitable level of care in ICU as a

contributor to mortality.(45) The African Surgical Outcome Study conducted in 2018 about perioperative outcome has disclosed that more that 95% surgical deaths occur after surgery. This can explain poor post-operative care in LMICs that do not detect and manage postoperative physiological changes and lack of resources to deal with postoperative complications.(46) There is no harmonized system for notifying postoperative outcome or length of stay after surgery. Thus, mortality and reoperation requirements are used as markers of in hospital post-operative outcome.(47) Patient factors, operative approaches and techniques, and hospital factors are determinants of post-operative outcome.(47)

Previous studies in developing countries about the outcome of surgical patients admitted in the ICU have proved that the mortality rate is still high. In multidisciplinary ICU of Lubumbashi University Teaching Hospital in the Republic of Congo, over all ICU mortality was 43.7% and surgical patients' death rate was 19.8%.(48) Shorter ICU stay, defined as less than 4 days, male gender, older age and medical diagnosis were determinants of Lubumbashi ICU mortality.(48) Another general ICU in Uganda at Mulago Hospital, mortality was also 43.7% and surgical admissions death rate was 37.4%.(49) In the surgical critical care of Pakistan, mortality was 45.3% and it was associated with advanced age and unplanned admissions.(50) In Yemen, research has demonstrated a low mortality rate of 20% in its surgical ICU where aging and male sex were found to be contributing factors of mortality.(12)

Length of hospital stay (LOHS) may differ from postoperative stay.(51) LOHS is defined as days a patient spent on hospital bed since admission until discharge while postoperative stay is counted from surgery day up to discharge.(51) There is no universal agreement about the definition of long of hospital stay also termed prolonged length of hospital stay (PLOHS) even if it is used a measure of postoperative outcome and quality of care.(51) PLOHS is defined as LOHS equals or greater than 75^{th} percentile in a given cohort study.(52) There are many factors that influence LOHS classified as pre-, intra- and postoperative like anemia, ASA status and post-operative disposition.(53)(54) Like PLOHS, postoperative prolonged ICU stay lacks a common understanding. However, T. Chinachoti et al. defined it as more than 4 days in ICU after surgery.(55)But Y. Huang et al explained it as a period of time ranging between 7 and 21 days for an operated patient stayed in critical care.(56)

CHAP III. METHODOLOGY

III.1 Study site

This study was conducted in two tertiary hospitals in Rwanda: The University Teaching Hospital CHUB and CHUK.

CHUB is located at Mamba, Cell of Butare within district of Huye, in the South Province of Rwanda. It is a national reference hospital which serves mainly the populations of Southern Province and others from Western Province's districts. CHUB was built in 1928, by the time, it was Butare Hospital. It was upgraded and become University Teaching Hospital in 1966. In 2000, The CHUB was established by law with autonomous status. It has around 500 beds capacity including 7 ICU beds

The CHUK, as the vast hospital of the country, is located in District of Nyarugenge, Kigali City. CHUK provides Rwandese residents with high-quality medical services, training, clinical research and technical support from provincial and districts hospitals. It was created in 1918 and operated as a low-level health facility since 1928. In 1965 it formally became a hospital. It has developed from health center, district hospital up to becoming referral hospital, from 1994 to 1996. In 2000, via the initiation and structuring of the University Teaching Hospital, CHUK became an institution with legal personality known as "University Teaching Hospital of Kigali." It is the vast referral hospital in Rwanda with accommodation of 565 beds including 10 ICU beds with hemodynamic monitoring devices and mechanical ventilation.

III.2 Study period

The study was carried out over a 10 months period from June 2020 to April 2021

III.3 Study design

This was a comparative cohort study operated in the above-mentioned hospitals assessing the association between lack of intensive care unit access and hospital mortality as well as length of stay in hospital for operated ACS patients with CARES more than 20 points in comparison to their counterparts who have got ICU admission.

IV.4 Study population

Participants in this study were ACS patients consulted emergency department units of CHUB and CHUK with conditions requiring emergency surgery defined as operative intervention within 48 hours of admission.

III.5 Selection of the study population

III.5.1 Inclusion criteria

1. ACS patients with CARES more than 20 points who had surgery within 48 hours of hospital admission.
2. Age more than 14 years' old

III.5.2 Exclusion criteria

1. Patients treated with non-operative management
2. Patients who died before surgery
3. Patients who were admitted in ICU preoperative
4. Patients needing surgical care with severe co-morbidities
    - Confirmed
        i. Kidney disease in end stage
        ii. Liver disease in end stage
        iii. Advanced malignancy under palliative care

III.5.3 Sample size calculation

The sample size calculation was done using the formula of Kasiulevičius of Cohort Studies

$$n = \frac{\left[Z_\alpha \sqrt{(1+m)\bar{p}'(1-\bar{p}')} + Z_\beta \sqrt{p_1(1-p_1) + m\,p_0(1-p_0)}\right]^2}{(p_1 - p_0)^2}$$

$$\bar{p}' = \frac{p_1 + p_0 / m}{1 + 1/m}$$

Kasiulevičius et al., n.d.

n = Total number of study subjects (cases) to determine the real relative risk with type I error in both directions

m = Number of subjects (controls) per experimental subject

Zβ = This is the desired power (0.84 for 80% power and 1.28 for 90% power)

Zα = critical value and a standard value for the respective confidence level. (95% CI 1.96 and 99% CI or type I error 2.58)

P0 = Probability of event in controls

P1 = Probability of event in trial

p = P1 + Po / m: 1 + 1 / m

Previous study about the association between mortality and denial admission to ICU has proved that early admission to ICU was resulting in mortality of 27% versus 37 % for patients who were initially denied transfer to critical care.(57) Our research wished to carry out the study with 95% Confidence Interval (CI) and power of 90% P0=27%, P1=37%, Zα= 1.96, m=1 (ratio of non-ICU patients to ICU patents). Substitution of variables in the above formula gave us N=187. The study required a minimum of **187 subjects.**

III.6 Study enrollment and data collection

General surgery residents --- mainly those working in ACS service --- were trained about the use of CARES surgical risk calculator (Table.1 and appendix). They screened all ACS patients consulting emergency departments of CHUB and CHUK requiring emergency surgery as well as those patients already admitted in other services who needed emergency surgery. Screened patients using CARES surgical risk calculator and scored more than 20 points were enrolled in the study.

A pre-established questionnaire was filled for each participant and handed back to the investigator. The questionnaire was divided into 4 distinct sections: the first one for socio-demographic patient's information, the second for preoperative evaluation, the third section for management and the fourth being the outcome of participant (Appendix). We collected socio-demographic information on gender, age, ubudehe category, life insurance and hospital where the patient consulted.

The section of preoperative evaluation was composed of diagnosis, duration of the symptoms, comorbidities and ASA score. qSOFA score includes GSC<15, Respiratory Rate ≥22 and Systolic BP ≤100 mmHg. Sepsis was defined as proven or suspected source of infection plus 2 or more qSOFA points. Septic shock was explained by presence of sepsis plus persistence of hypotension despite adequate fluids resuscitation and need of vasopressors to maintain MAP ≥65 mmHg.(58)

In the management, timing of surgery was defined by the World Society of Emergency Surgery study group initiative on Timing of ACS classification which recommends surgical intervention to be performed not beyond 48 hours of admission for every ACS patients and within 6 hours for those patients likely to need post-operative critical care management.(59) Performed surgical procedure, perioperative events like need of blood transfusion and inotropes and post-operative disposition were recorded. Acute renal failure was defined according to kidney disease improving global outcome (KDIGO) guidelines that include any of the following (1) increased serum creatinine within 0.3mg/dL, (2) increasing serum creatinine to 1.5x baseline or (3) urine output below 0.5 mL/kg/h for 6 hours.(60)

The outcome section comprised duration of patient in PACU, duration on mechanical ventilation, duration in ward and over all hospital stay. Death location was also recorded and over all outcome of in-hospital until 30 days including discharged, death and still hospitalized. For post-operative disposition, immediate ICU admission was defined as spending 6 hours or less in PACU before reaching ICU. Delayed ICU access was defined as waiting more than 6 hours in PACU after completion of surgery an ICU bed availability for an ACS patient with CARES more than 20 points. No ICU access included all patients who have been admitted to the surgical ward postoperatively. For patients who died intraoperatively or in the PACU, they were considered and analyzed as patients who had no access to ICU service.

In our study, patients have been followed since admission up to 30 days in hospital, mortality and length of stay in hospital were our outcome of interest.

III. Statistical analysis

The collected information from each questionnaire was entered into excel data base. Data analysis was done using SPSS version 25.0 (IBM Corporation, New York 10504-1722, USA). Percentages and means were used for descriptive statistics. For categorical variables with comparison groups not exceeding 2, Fischer's exact test was used. Otherwise, chi-square test was used. For continuous variables, Mann-Whitney U test were used to compare the numerical ranked variables. A p –value of 0.05 or less was considered statistically significant. Odds ratio (OR) and 95% confidence interval (CI) was estimated using logistic regression analysis.

We compared 30 days mortality and length of hospital stay in patients with immediate ICU admission versus delayed ICU admission and lacked ICU access using chi-square test, logistic

regression for categorical variables and ANOVA for continuous ones. Furthermore, the analysis of factors associated with mortality, chi-square test was used.

III. 9 Ethical consideration and Dissemination

- To be enrolled in the study, the consent was obtained from the competent patient and assent for the debilitated incapacitated patient from the caretaker
- Before conducting the study, the approval was secured from the Institutional Review Board (IRB) of University of Rwanda (UR) and the Ethic Committees of CHUB and CHUK,
- The patient's information was kept confidentially in both centers by the residents in sealed envelopes until the end of data collection,
- The primary investigator sent the sealed envelopes to the statistician who proceeded with the analysis.
- The patient had the right to leave the study if he/she no longer wanted to be part of it.

CHAP IV. RESULTS

During a 10-month period, 708 ACS patients were evaluated using CARES surgical risk calculator through emergency department units of CHUB and CHUK. Among them, 213 (30%) had CARES > 20 points. (Figure 4.1)

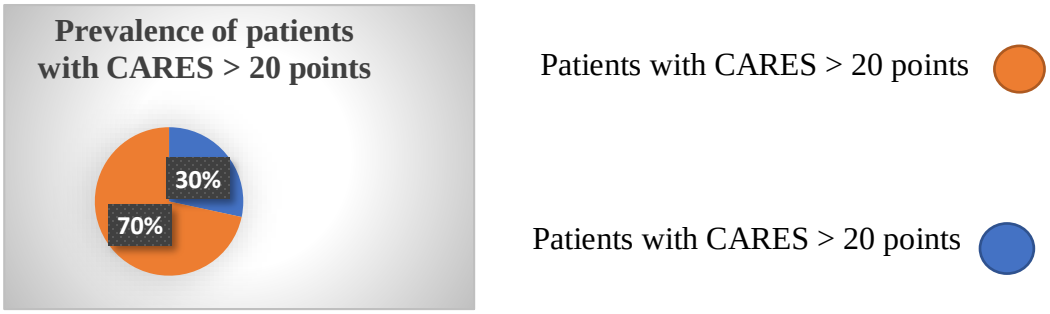

Figure. 4.1. The rate of ACS patients who may need post-operative ICU admission

Most of ACS patients with CARES> 20 points (n=139, 65.3%) were male (Table 4.2). Minimum age was 15 years and maximum being 97 years with average age of 46 years (interquartile range [IQR]: 31, 64). Many patients (n=166, 78 %) were not having any comorbidities (Figure 4.2). The most common recognized comorbidities included hypertension (n=17, 8%), Diabetes mellitus (n=12, 6%) and HIV/AIDS (n=5, 10.6%). The mean duration of symptoms in ACS patients with CARES > 20 points was 6.68 days.

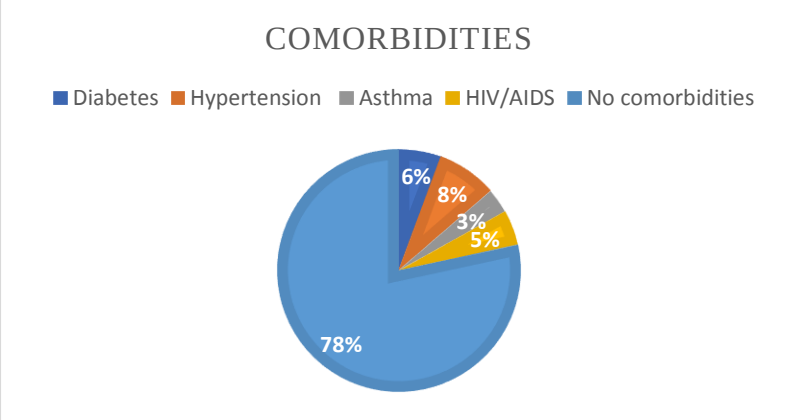

Figure 4.2. Distribution of comorbidities in ACS patients with CARES> 20 points at CHUB and CHUK

Clinical assessment of ACS patients with CARES>20 points (Table 4.1) found that many (n=164, 77%) were classified into ASA status III. Sepsis was in 138 (64%) patients. Intraoperative hypotension and need of inotropes were required in 120 (54%) patients. Timely surgery within 6 hours of decision was done in 115 (54%) patients. qSOFA score 2 was found in 95 (44.6%) and AKI was present in 47 (22.1%). Mean CARES score among ACS patients who were qualified for post-operative ICU admission was 27.8 points with standard deviation of 3.9.

The most common indications of surgery were complicated intestinal obstruction (36.6%), peptic ulcer perforation (23.5%), appendicular perforation (9.4%) and typhoid perforation (8.5%). Common procedures performed was bowel resection and anastomosis (34.7%), gastric perforation repair (22.4%), bowel resection and stoma (19.7%), and appendectomy (9.4%).

Table. 4.1. Clinical assessment of ACS patients with CARES >20 points at CHUB and CHUK

Variable	**Category**	**Count**	**Percentage**
AKI	N	166	77.9%
	Y	47	22.1%
ASA Score	II	14	6.6%
	III	164	77.0%
	IV	34	16.0%
	V	1	0.5%
qSOFA score	0	42	19.7%
	1	34	16.0%
	2	95	44.6%
	3	42	19.7%
Sepsis	N	75	35.2%
	Y	138	64.8%
Septic shock	N	183	85.9%
	Y	30	14.1%
Preoperative inotropes	N	205	96.2%
	Y	8	3.8%

Surgery within 6 hours of decision	N	98	46.0%
	Y	115	54.0%
Blood transfusion	N	133	62.4%
	Y	80	37.6%
Intraoperative Hypotension and need of inotropes	N	93	43.7%
	Y	120	56.3%
Cardiac arrest and CPR	N	207	97.2%
	Y	6	2.8%

The rate of post-operative ICU access in ACS patients with CARES >20 points (Figure 4.3) was (38.5%, N=82). Immediate post-operative ICU admission was 24.9% (N=53) and delayed ICU post-operative admission was observed in 13.6% (N=29). Lack of ICU access included patients who were admitted into surgical ward (52.6%, N=112), patients died in PACU (8.5%, N=18) and those died in operative room (0.5%, N=1)

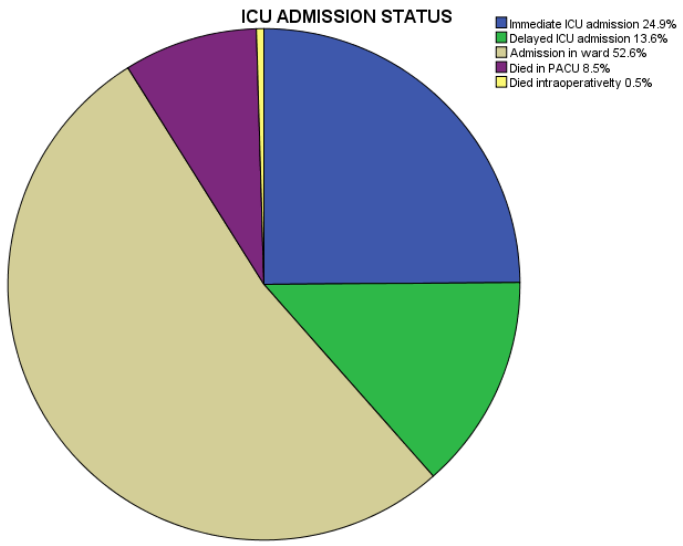

Figure 4.3. Post-operative disposition of ACS patients with CARES > 20 points at CHUB and CHUK

The overall mortality rate in ACS patients with CARES> 20 points was 48.4% (Table 4.2). The mortality rate within patients who were immediately admitted in ICU was 26.4% compared to 89.7% for patients who had delayed ICU admission, and 48.1% among patients who lacked post-

operative ICU access. ACS patients who delayed to be admitted in ICU are 24 times more like to die compared to people who were immediately admitted in ICU (95% CI, 6.304-92.393, p-value <0.001). Patients who did not have access to ICU, they were 3 times more likely to die in comparison to patients who immediately accessed ICU (95%CI, 1.281-5.199, p-value <0.001)

Table 4.2. Mortality of ACS patients with CARES >20 points who got immediate post-operative ICU access versus those who had delayed access or no access to ICU

Variable		Outcomes		OR (95% CI)	p-value
ICU admission status		Alive, N (%)	Dead, N (%)		**<0.001**
	Immediate admission	39(73.6)	14(26.4)	Reference	
	Delayed admission	3(10.3)	26(89.7)	24.143(6.304-92.393)	
	No access to ICU	68(51.9)	63(48.1)	2.581(1.281-5.199)	
Overall mortality rate		109(51.6)	103(48.4)		

Concerning length of hospital stay (Table 4.3) Patients who did not accessed ICU spent many days in hospital than those patients who had accessed to ICU. Patients who did not have access to ICU, the mean hospital stay was 16.5 days while patients who accessed ICU, the mean hospital stay was 13.7 days (p-value <0.001). People who delayed to be admitted in ICU spent few days in both ICU and ward due to the fact that there was may death from patients with ICU admission delay.

Table 4.3. Length of hospital stay in ACS patients with CARES >20 points who got immediate post-operative ICU access versus those who had delayed access or no access to ICU

	Immediate ICU admission (N=53)	Delayed ICU admission (N=29)	No-ICU admission (N=131)	P-value
Length of ICU stay	5.887	5.034	Not Applicable	<0.001
Length of ward stay	8.245	1.172	14.853	<0.001
Total hospital stay	13.660	7.138	16.495	<0.001

Factors that were observed to influence the mortality in ACS patients with CARES> 20 points regardless of their post-operative disposition (Table 4.4.1-2). Intraoperative hypotension and need of inotropes (p-value <0.001), ASA status III and above (p-value <0.001), AKI (p-value <0.001), qSOFA score ≥2 (p-value <0.001), need of preoperative inotropes (p value=0.003) and lack of medical insurance (p-value = 0.004)

Table 4.4.1. Factors influenced mortality among ACS patients with CARES > 20 points

Variables		**Over all 30 days in-hospital outcome**		
		Alive	**Death**	
		Count	**Count**	**P-value**
Age group	<50	69	52	0.071
	>50	41	51	
Sex	F	40	34	0.607
	M	70	69	
Symptom's duration	<2 days	11	8	0.568
	>2 days	99	95	
Preoperative inotropes	N	110	95	**0.003**

	Y	0	8	
Surgery within 6hours of decision	N	47	51	0.321
	Y	63	52	
Blood transfusion	N	74	59	0.132
	Y	36	44	
Intraoperative Hypotension and need of inotropes	N	61	32	**<0.001**
	Y	49	71	
AKI	N	99	67	**<0.001**
	Y	11	36	
ASA status	II	9	5	
	III	96	68	**<0.001**
	IV	5	29	
	V	0	1	
qSOFA score	0	30	12	**<0.001**
	1	29	5	
	2	45	50	
	3	6	36	

Table 4.4.2 Factors influenced mortality among ACS patients with CARES > 20 points

Variable	Category	Over all 30 days outcome		
		Alive	Death	
		Count	Count	p-value
Ubudehe Category	I	17	16	0.493
	II	39	29	
	III	54	58	
Life insurance possession	**No**	**2**	**12**	**0.004**
	Yes	108	91	
Diagnosis	Appendicular perforation	13	7	0.182
	Blunt abdominal trauma	6	7	
	Complicated Intestinal Obstruction	37	42	
	Gangrene of the limb	2	4	
	Gastric perforation	0	2	
	Other	6	11	
	Penetrating abdominal trauma	2	3	
	Peptic ulcer perforation	32	18	
	Typhoid ileal perforation	12	8	

CHAP V. DISCUSSION

In this study, we have compared 30 days in-hospital mortality and hospital length of stay after surgery in ACS patients with CARES > 20 points who had early post-operative ICU admission versus delayed admission as well as those who lacked ICU access. The main findings of this comparative cohort study were high mortality rate in patients who lacked ICU access and delayed ICU admission groups compared to early admission. In addition, hospital stay in patients who had been admitted in surgical ward after operation were also high. However, lack of post-operative ICU access was common and represented 61.6% that included patients admitted to the surgical ward (N=112, 52.6%), patients whose death happened in PACU (N=18, 8.5%) and those who died in operative room (N=1, 0.5%)

Factors found to be independently correlating with mortality and hospital length of stay more than 30 days after operation were preoperative inotropes, intraoperative hypotension and need of inotropes, AKI, ASA status III and more, qSOFA score ≥2 and lack of life insurance. However, factors like preoperative and intraoperative need of inotropes, ASA status III and above, AKI and qSOFA ≥ 2 points, they were also noted in previous studies like Y Sim et. al. (54) and Abelha F at. al.(61) Both delayed ICU admission and lack of post-operative ICU access were linked to increased rate of death and longer in-hospital stay.

Immediate post-operative ICU admission rate was 24.9%, comparable to 23.3% in the previous study by Dünser et al.(32), low compared to 31.2% from Cardoso et. al.(18) but very high in comparison to the study "delayed admission to ICU for critically ill surgical patients is associated with increased mortality" by Y. U. Bing-Hua that was 91.9%.(9). This discrepancy in the rate of immediate or timely ICU admission can be explained by the following facts, those studies were conducted in (1) setting with no shortage of ICU infrastructures including beds (2) study that were included patients from all specialties while ours was only dealing with specific group of surgical patients.

The much higher mortality rate of 89.7% in the group that had a delayed ICU admission versus immediate admission (26.4%), was not comparable to the results from previous studies as it was high compared to 51% by S. Ahmed et al.(17) Even too high when compared to 30% mortality rate which was revealed by the study of Cardoso et.al.(18) and 33.2% by Churpek et al. study about "association between ICU transfer delay and mortality".(8)

This high mortality within this present study compared to previous ones could be due to the fact that (1) it was dealing with critically ill surgical patients who required emergency surgery (2) the patients in most of the time, were too sick to benefit from ICU admission as they have waited too much time in PACU for availability of an ICU bed.(34)

Our study had showed a mortality rate 48.1% in the group that has lacked post-operative ICU access. There are no available similar studies done in the region to compare with this current result. However, it was comparable to 43%, the mortality which was observed in the study preciously done in Tunisia about determinants and outcomes related to the decision to refuse admission to the ICU by R. Bouneb et. al.(7), but somehow high when collated to 30% mortality rate noticed from the impact on mortality from ICU admission refusal, study carried out in western of France by Robert et. al.(6). High mortality from our study in the group that has lacked access to ICU could be supported by the fact that these compared studies were conducted in settings where critically ill patients can be provided improved medico-surgical care in absence of critical care service.

The overall mortality rate for this present study was 48.4% which was almost similar to 47% pointed by previous study about factors influencing mortality in surgical patients admitted to CHUK ICU.(16) Within the region, our study's pooled mortality rate of patents who had post-operative access to ICU was closer that one's done in Uganda 40.1(49)(3) and in Democratic Republic of Congo 43.1%(48). This almost similarities of high ICU mortality across the region might possibly explained by the paucity of critical care service infrastructures and personnel which is still usual in developing countries and admission of severely ill patients in critical care.(11)

The mean length of over all hospital stay in the group of patients who have been admitted to critical care after surgery was 13.6 days significantly short period compared to their counter-parts who did not have post-operative ICU access which was 16.5 days. This short hospital stay in patients admitted to ICU was comparable to previous study done in Pakistan which has revealed average hospital stay of 12 days.(50) while the delayed ICU admission group of patients in our study has stayed average 7.1 days in hospital which was low compared to 13 days from Churpek et al.(8) and 19 days from Yun Su Sim, et al.(54) The short median days in over all hospital stay within our study could be explained by the early death that has occurred in severely ill surgical patients who have been delayed to be admitted in intensive care unit.

There were several limitations to this current study that should be considered when reading the findings. First, the study was not multicenter, so that the study's results cannot be universally applied to every hospital. Second, although, definition of patients who need post-operative critical care management was done using CARES surgical risk calculator prior to surgery but the decision for ICU admission was for physician discretion and absence of randomization are possible source of bias. Third, we were powerless in the assessment of long-term prognosis (involving period of 6 months or 1 year) associated with post-operative ICU access as we were restricted to 30 days in-hospital mortality and the length of hospital stay. It should be underlined that solely hospital mortality is apparently not sufficient as a sturdy outcome, mainly because we were unmindful of quality of life at discharge and outside the hospital. we were also unable to evaluate factors linked to ICU access but we had strengths like the universal tool, CARES surgical risk calculator to identify patients who will need post-operative critical care management, the period of the study that lasted 10 months and 30 days follow-up.

As far as we know, no similar research has been conducted so far in this region and African continent to evaluate the outcome of surgical patients who were operated while having criteria of post-operative critical care management and they did not have the access.

CHAP VI. CONCLUSION AND RECOMMENDATIONS

VI. 1 CONCLUSION

In this study, we have noticed that there is strong association between lack of post-operative ICU management and mortality and hospital length of stay in ACS patients with CARES> 20 points. The delayed ICU admission of ACS patients who have been operated having criteria of post-operative critical care management, their risk of death was found to be increased 24-fold. This could be explained by the fact that not only early surgical intervention is paramount to critically ill surgical patients but also appropriate and timely post-operative disposition are keys to avoid preventable death.

We have also eyed, during the study, an increased length in-hospital stay for ACS patients with CARES > 20 points who were operated and lacked ICU access or had a delayed ICU admission compared to their counterpart who had timely critical management. This statement means that delayed or lack of suitable management after operation of severely patients results in a prolongation of stay in hospitalization.

VI. 2 RECOMMENDATIONS

In the light of the aforementioned results, we would recommend:

To the hospitals and physicians to have a systematic approach of evaluating a every surgical patient especially ACS ones, for post-operative need of critical management in order to decide surgery having planned about proper post-operative disposition.

To hospitals to revise or set fitting criteria of ICU admission so that critical care service is reserved for patients who can improve rather than patents too sick or too good. This can prevent misuse and increased ICU mortality.

To decision-makers in health to consider investment in critical care settings to have adequate ICU beds and equipment so that those patients who are critically ill may benefit from post-operative smooth recovery and critical care management in ICU.

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Appendices

Appendix 1. Data Collection Questionnaire

Research Title: *Association between lack of ICU access and hospital mortality in Acute Care Surgery (ACS) patients with combined assessment of risk encountered in surgery (CARES) more than 20 points at Butare and Kigali University Teaching Hospitals.*

Principal investigator:

MANIRABONA Emmanuel, MD, Resident in General Surgery

Supervisors:

Prof. Ntirenganya Faustin, MD, MMED, FCS, PhD, Consultant General & Onco-Plastic Surgeon

Dr Jennifer Rickard, MD, MPH, Surgery and Critical Care

DATA COLLECTION FORM

1. **Patient Demographics**

Hospital: (Choose one)…..CHUB……CHUK

Admission date……../……./……..

Patient's initials:…….

Hospital ID:……..

Age:……..(Years)

Gender:…….M……F

Ubudehe Category:…….1…….2……3……4

Life insurance possession:……Yes……No

2. **Preoperative Evaluation**

Diagnosis (choose below)

1. Complicated intestinal obstruction

2. Peptic ulcer perforation
3. Appendicular perforation
4. Typhoid perforation
5. Blunt abdominal trauma
6. Penetrating abdominal trauma
7. Limb gangrene
8. Other (explain):

Duration of symptoms:……days

Comorbidities (choose all apply)

1. Diabetes mellitus
2. Hypertension
3. Smoker
4. Alcohol intake
5. Asthma
6. HIV/AIDS
7. AKI was described by Kidney Disease Improving Global Outcome (KIDGO) guidelines as any of the following
    a. Rise in serum creatinine by 0.3mg/dL or more in the last 2 days
    b. Increasing serum creatinine to 1.5 times from baseline or more
    c. Urine output below 0.5 mL/kg/h for 6 hours
8. No comorbidity

ASA score: (check one box)

1. **I** Normal healthy patient
2. **II** Patient with mild systemic disease
3. **III** Patient with severe systemic disease
4. **IV** Severe systemic disease that is a constant threat to life
5. **V** Moribund patient who is not expected to survive without the operation
6. **VI** Patient declared brain-dead; organs are being removed for donor purposes

qSOFA score based on GSC<15, Respiratory Rate ≥22 cpm and Systolic BP ≤100 mmHg (choose points)

- 0
- 1
- 2
- 3

Sepsis: (defined as proven or suspected source of infection plus 2 or more qSOFA points

- Yes
- No

Preoperative need of vasopressors

- Yes
- No

Septic shock: (defined as presence of sepsis plus persistence of hypotension despite adequate fluids resuscitation and need of vasopressors to maintain MAP ≥65 mmHg)

- Yes
- No

CARES points (calculated using table 1, 2&3):……..points

3. MANAGEMENT

Timing of surgery was defined by World society of emergency surgery study group initiative on Timing of ACS classification

- 6hrs (admission)
- >6hrs of admission

Date of operation:……../……../……..

Performed procedure (choose below)

1. Gastric perforation repair

2. Duodenal perforation repair
3. Bowel perforation repair
4. Bowel resection and anastomosis
5. Bowel resection and stoma
6. Splenectomy
7. Appendectomy
8. Transfemoral amputation
9. Transtibial amputation
10. Other (explain):

Intraoperative event:(choose all apply)

1. Blood transfusion
2. Hypotension defined as need of inotropes
3. Cardiac arrest and cardiopulmonary resuscitation (CPR)
4. None above

Post-operative disposition (choose one below)

1. Immediate ICU admission
2. Delayed ICU admission defined as staying more than 6 hours in PACU
3. Admission in ward
4. Died in PACU
5. Died intra-operative

4. **OUTCOME**

Duration in PACU:…… hours

Duration on mechanical ventilation:

- ……(days)
- More 30 days

Over all stay in ICU :

- ……(days)
- More 30 days

Duration in ward admission :

- ……. (days)
- More 30 days

Over all stay in hospital:

- …….. (days)
- More 30 days

- **Death location** (check one box**)**
    1. ICU
    2. Ward
    3. PACU
    4. Intra-operative

Over all outcome of 30 days in hospital follow up (check one box**)**

1. Discharged
2. Dead
3. Still hospitalize

Appendix.Table.1. Points of CARES surgical risk calculator

CARES SCORING			**Points**
Type of surgery	**Emergency:** defined as condition requires immediate surgery		5
Procedures	Laparotomy		5
	Thoracotomy		5
	Amputation	Trans-femoral/tibial	5
		Trans-radial/humeral	
	Procedure's risk (all above procedures)		5
Age (years)	<30		0
	30-49		4
	50-74		7
	75-84		8
	>85		10
Sex	Male		2
	Female		0
Red cell distribution	≤ 15.7		0
	>15.7		3

width (RDW)			
Co-morbidities	Anemia degree classified by WHO	None	0
		Mild ♀Hb:11-12.9g/dL ♂Hb:11-11.9g/dL	2
		Moderate to severe ♂ n ♀Hb<10.9 g/dL	5
	ASA (American Society of Anesthesiology)	ASA1 or ASA2	0
		ASA3	7
		≥ASA4	11
	History of ischemic heart disease	No	0
		Yes	3
	History of Congestive heart failure	No	0
		Yes	2

Appendix.Table.2. Interpretation of CARES surgical risk calculator

Score	**Risk related to surgical procedure**	**Risk (%) of death within 30 days**	**Risk (%) related to post-op ICU stay > 24hrs**	**Recommendation**
0-10	Low	0	0.1	Continue with surgery
11-20	Low-moderate	0.2	0.9	Patient resuscitation then proceed with surgical procedure
21-31	Moderate-high	1.9	4.9	Prepare for suitable post-operative management and monitoring and ICU admission
>31	High	11.5	14.9	Do not operate the patient without an ICU bed availability. Or Do non-operative management

Appendix.2 Consent Form

Inyandiko yo kwemera kwitibira ubushakashashatsi isinywa n'umurwayi cg uhagarariye byemewe n'amategeko umurwayi witabira ubushakashatsi

Inyito y'ubushakashatsi***: Isano iri hagati yo kubura igitanda mu nzu y'indembe kubera yuzuye n'inkurikizi zishobora kuba ku murwayi wabazwe***

Umushakashatsi: Dr MANIRABONA Emmanuel (Tel:0785974335)
Ikigo abarizwamo: Kaminuza nkuru y'u Rwanda- koleje y'ubuvuzi n'ubundi bumenyi mu by'ubuvuzi (UR-CMHS)

I. AMAKURU YEREKEYE UBUSHAKASHATSI

INTANGIRIRO

Nitwa MANIRABONA Emmanuel, umuganga nkaba n'umunyeshuli wiga ibijyanye no kubaga icyikiro cya gatatu cya kaminuza. Ndabasaba kwitabira ubushakashatsi ndimo nkora. Turabasaba gusoma neza iyi nyandiko cg tukaba twabasomera mu gihe mutabibasha. Ibibazo byose mwagira turabibasubiza mbere yo gushyira umukono kuri iyi nyandiko. Kwitabira ni ubushake kandi ushobora kubihagarika igihe cyose ubishatse.

INTEGO Y'UBUSHAKASHASHATSI

Kubura igitanda mu nzu y'indembe kandi umurwayi yari agikeneye ni bintu bikunze kubaho cyane mu bihugu byinshi bikiri mu nzira y'abajyambere n'igihugu cyacu cy'u Rwanda kirimo. Iyo umurwayi wari ukeneye igitanda mu nzu y'indembe atabashije kukibona bishobora kumugiraho ingaruka nyinshi zirimo gutinda gukira igihe yagombaga kumara ari mu bitaro kikiyingera ndetse rimwe na rimwe bikamuviramo kuba yabura ubuzima.
Muri ubu bushakashati tuzakurikira abantu bose babuze igitanda mu nzu y'indembe kandi bari bagikeneye tubagereranye n'abangenzi babo babashije kukibona tureba ingaruka mbi abatabashije kubona igitanda bashobora kugira tugereranije n'abakibonye.
Ibi bizadufasha kumenya uburyo abantu batugana bakeneye kubagwa kandi bari buze gukenera igitanda mu nzu y'indembe twarushaho kubaha ubufasha ku burwayi bwabo, bityo tugabanye inkurikizi mbi zaterwa no kubagwa hakenewe igitanda mu nzu y'indembe kandi ntagihari

UBWOKO BW'UBUSHAKASHATSI N'UBURYO ABAZABWITABIRA BAZATORANYWA

Ubu bushakashatsi bugizwe no ugukurikirana abarwayi gusa. Abarwayi bazitabira ubushakashatsi tuzabakurikirana kuva bakinjira mu bitaro kugeza basezerewe cg iminsi 30 bakirimu bitaro, bazaba bahabwa ubuvuzi busanzwe bugendanye n'uburwayi bafite naho bazaba babashije kubona igitanda cg bakibuze mu nzu y'indembe

Abazitabira ubu bushakashatsi n'abarwayi bose bafite uburwayi bukenewe kubagwa byihutirwa kandi bigaragara ko bakeneye igitanda mu nzu y'indembe nyuma yo kubagwa baba bari bukibone cyangwa ntacyo bari bubone bitewe n'uko inzu y'indembe yuzuye

KWITABIRA KU BUSHAKE

Kwitabira ubu bushakashatsi ni ubushake busesuye. Kutitabira ubushakashatsi ntacyo bizahindura ku ubuvuzi umurwayi yari buhabwe

INYUGU ZO KWITABIRA UBUSHAKASHATSI

Ntanyungu z'ako kanya ziri mu kuba umurwayi yitabiriye ubu bushakashatsi, gusa mu gihe kizaza umurwayi ubwitabiriye cyangwa abandi bazungukira mu kubona ubuvuzi bwiza bushingiye ku bizaba byaravuye muri ubu bushakashatsi

INYISHYU

Nta mafaranga cg impano izahabwa umurwayi cyangwa umuhagarariye uzaba yitabiriye ubu bushakashatsi

IBANGA KU BAZITABIRA UBUSHAKASHATSI

Amakuru y'uwitabiriye ubushakashatsi ni ibanga. Amakuru yose azafatwa ku bijyanye n'uburwayi bw'uzitabira ubu bushakashatsi azabikwa ahantu hatagerwa n'undi muntu uwo ariwe wese uretse abakora ubushakashatsi.

Urupapuro ruriho amakuru ruzandikwaho numero y'ubushakashatsi aho gushyiraho izina kandi rubikwe ahantu hafungwa.

GUTANGAZA IBYAVUYE MU BUSHAKASHATSI

Ntiduteganya gutangariza buri muntu ibyavuye mu bushakashatsi, gusa umuntu ubyifuje twabimumenyesha ku giti cye. Ikindi ni uko ibyavuye mu bushakashatsi bizatangazwa binyuze mu nama cg ibinyamakuru byabugenewe.

AHO WABARIZA AMAKURU KURI UBU BUSHAKASHATSI

Ubu bushakashatsi bwasuzumwe kandi bwemezwa n' ikigo cya Kaminuza y'u Rwanda, ishami ry'ubuvuzi n'ubundi bumenyi mu by'ubuvuzi (IRB). Iki kigo gishizwe kwiga no kwemeza imishinga y'ubushakashatsi kandi kikareba niba ubushashatsi budahungabanya cg ngo bugire ingaruka mbi ku babwitabiriye.

GAHUTU Jean Bosco ukuriye iki kigo kuri numero ye igendwanwa +250783340040

II. KWEMERA KWITABIRA

Njyewe…….. Nemeye ku bushake bwanjye kwitabira ubushakashatsi.

Nyewe…….uhagarariye umurwayi……isano dufitanye……..

Nzi neza ko nubwo nemeye ko yitabira, nshobora kubihagarika igihe icyo ari cyo cyose kandi nta nkurikizi ku buvuzi ngomba guhabwa

Abunganizi

Prof NTIRENGANYA Faustin, Tel: 0788732667, E-mail: fostino21@yahoo.fr

Dr Jennifer Rickard, Tel: 0787178671, E-mail: jlr283@mail.harvard.com

Ndemeza ko umurwayi ashyize umukono kuri iyi nyandiko bigendeye ku makuru yahawe

Umukono w'umushakashatsi n'italiki	Umukono w'umurwayi cg uhagarariye umurwayi
…….	…….
Tariki ya ……./……/20….	……./……/20…

Appendix.3 Ethical approval

IRB approval

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DIRECTORATE OF RESEARCH & INNOVATION

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 17th/June/2020

Dr Manirabona Emmanuel
School of Medicine and Pharmacy, CMHS, UR

Approval Notice: No 133/CMHS IRB/2020

Your Project Title "***"Association Between Lack Of Intensive Care (ICU) Access And Hospital Mortality In Acute Care Surgery ACS) Patients With Combined Assessment Of Risk Encountered In Surgery (CARES) More Than 20"***," has been evaluated by CMHS Institutional Review Board.

		Involved in the decision		
			No (Reason)	
Name of Members	**Institute**	Yes	**Absent**	**Withdrawn from the proceeding**
Prof Kato J. Njunwa	UR-CMHS		X	
Prof Jean Bosco Gahutu	UR-CMHS	X		
Dr Brenda Asiimwe-Kateera	UR-CMHS	X		
Prof Ntaganira Joseph	UR-CMHS	X		
Dr Tumusiime K. David	UR-CMHS	X		
Dr Kayonga N. Egide	UR-CMHS	X		
Mr Kanyoni Maurice	UR-CMHS		X	
Prof Munyanshongore Cyprien	UR-CMHS	X		
Mrs Ruzindana Landrine	Kicukiro district		X	
Dr Gishoma Darius	UR-CMHS	X		
Dr Donatilla Mukamana	UR-CMHS	X		
Prof Kyamanywa Patrick	UR-CMHS		X	
Prof Condo Umutesi Jeannine	UR-CMHS		X	
Dr Nyirazinyoye Lactitia	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 17th June 2020, **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

CHUK approval

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Quality Health Care
Training & Research

Ethics Committee / Comité d'éthique

16,Oct,2020 *Ref.:EC/CHUK/086/2020*

Review Approval Notice

Dear Emmanuel Manirabona,

Your research project: ***"Association between lack of Intensive Care Unit (ICU) access after surgery and hospital mortality in Acute Care Surgery (ACS) patients with Combined Assessment of Risk encoutered in Surgery (CARES) more than 20 "***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 16,Oct,2020 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=140&&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

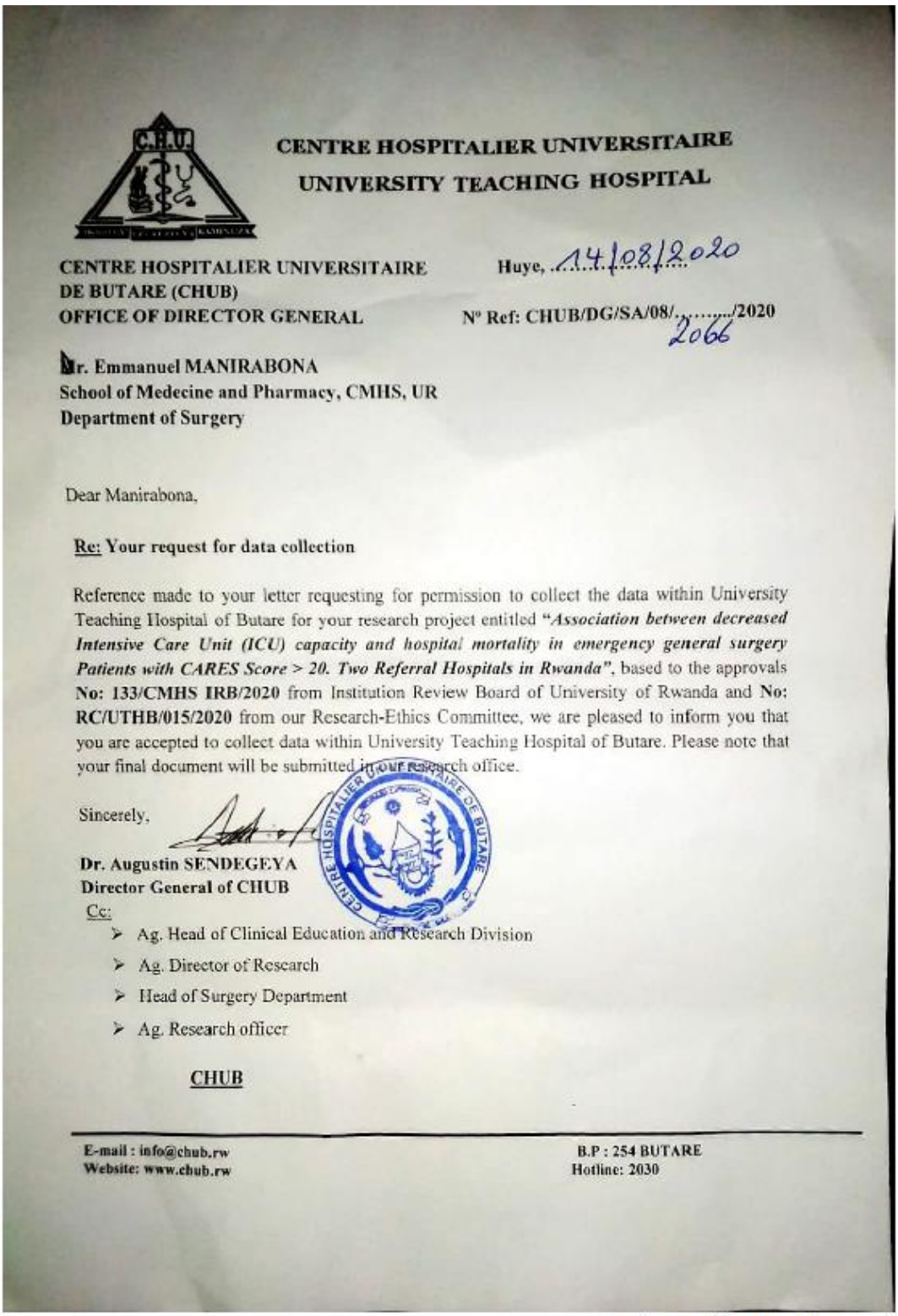
ETHICS COMMITTEE
CHUK

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 "

B.P. :655 Kigali- RWANDA www.chuk.rw Tél. Fax : 00 (250) 576638 E-mail :chuk.hospital@chukigali.rw

CHUB approval



CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

CENTRE HOSPITALIER UNIVERSITAIRE DE BUTARE (CHUB)
OFFICE OF DIRECTOR GENERAL

Huye, 14/08/2020

N° Ref: CHUB/DG/SA/08/2066/2020

Mr. Emmanuel MANIRABONA
School of Medecine and Pharmacy, CMHS, UR
Department of Surgery

Dear Manirabona,

Re: Your request for data collection

Reference made to your letter requesting for permission to collect the data within University Teaching Hospital of Butare for your research project entitled ***"Association between decreased Intensive Care Unit (ICU) capacity and hospital mortality in emergency general surgery Patients with CARES Score > 20. Two Referral Hospitals in Rwanda"***, based to the approvals **No: 133/CMHS IRB/2020** from Institution Review Board of University of Rwanda and **No: RC/UTHB/015/2020** from our Research-Ethics Committee, we are pleased to inform you that you are accepted to collect data within University Teaching Hospital of Butare. Please note that your final document will be submitted in our research office.

Sincerely,

Dr. Augustin SENDEGEYA
Director General of CHUB

Cc:

- Ag. Head of Clinical Education and Research Division
- Ag. Director of Research
- Head of Surgery Department
- Ag. Research officer

CHUB

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