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Indications for admission and predictors of early outcomes among surgical patients admitted in the Intensive Care Unit at Bugando Medical Centre, Mwanza, Tanzania

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Abstract

Background: Critically ill surgical patients have been reported to be a major cause of hospitalization and intensive care utilization worldwide and consume a significant amount of the healthcare budget. There is a paucity of published data on intensive care utilization in our environment. Therefore, we thought it was necessary to conduct this study to describe the common indications and predictors of outcomes of surgical patients admitted to the intensive care unit (ICU) in our setting and compare our results with those from other centers in the world.

Methods: This was a descriptive longitudinal study involving surgical patients admitted to the ICU from August 2017 to May 2018. Before the study commenced, ethical approval to conduct it was obtained from the relevant authority.

Results: 199 surgical patients (M: F = 1.7:1), representing 55.7% of all ICU admission, were studied. The median age of patients was 32 years. Postoperative observation/close monitoring following surgery and mechanical ventilation were the most common indications for ICU admission in 138 (69.4%) and 61 (30.7%) patients, respectively. The general surgery specialty had the highest number of patients admitted to the ICU (33.7%). The overall ICU median length of hospital stay (LOS) was 18 days. High ASA class, emergency surgery, higher APACHE score, high temperature and presence of postoperative complications were the main predictors of prolonged LOS ($p < 0.001$). The overall ICU mortality was 39.2% and it was significantly associated with advanced age (>65 years), delayed ICU admission (>72 hours), admission systolic blood pressure < 90 mmHg, $PaO_2 < 90$, need for ventilatory support, high admission modified APACHE II score and high serum urea levels ($p < 0.001$).

Conclusion: Postoperative observation/close monitoring following surgery and mechanical ventilation remain the most common indications for ICU admission at BMC. Therefore, the recovery room and the surgical high dependency unit (SHDU) of BMC should be well equipped with modern facilities for care of critically ill post-operative patients to reduce the number of ICU admissions. Factors responsible for prolonged LOS and high mortality in our patients should be addressed to be able to improve the outcome of these patients

Key words: Intensive care unit, indications for admission, predictors, early outcomes, Tanzania

Introduction

The Intensive Care Unit (ICU) is a specialized hospital that manages critically ill patients using advanced medical and nursing care, monitoring, and multiple modalities of physiological organ supports (Marshall *et al*., 2017). The goal of ICU admission is to prevent morbidity and mortality among patients who are at high risk through the provision of critical care (Kirubel *et al*., 2020).

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Therefore, critically ill patients who need sophisticated airway, respiratory, and hemodynamic support are typically transferred to the ICU, where they receive advanced treatment, and both invasive and noninvasive monitoring to achieve a better outcome (Murthy *et al*., 2013; Marshall *et al*., 2017). Currently, ICUs of most hospitals in developed countries have become separate departments staffed by career intensive care physicians or intensivists from various fields of medicine (Kirubel *et al*., 2020). In Tanzania, however, ICUs are still part of the anaesthesia department and critical care constitutes a substantial part of the workload and responsibilities of anesthetists (Chalya *et al*., 2011; Sawe *et al*., 2014).

The utilization of the ICU presents a challenge to healthcare providers, especially in low or middle-income countries (LMICS) like Tanzania, due to the paucity of skilled personnel and equipments (Idowu *et al*., 2010; Chalya *et al*., 2011; Sawe *et al*., 2014; Goldwasser *et al*., 2016). Limited number of ICU beds, lack of sufficiently trained healthcare professionals, constraints in critical technologies, shortages of medications and scarce data on patients' outcome are the major challenges of the critical care in LMICs (Murthy *et al*., 2013). Owing to scarcity of ICU beds, only the most critical patients are to be provided ICU care (Singh *et al*.,2020). Hence, there appears a strong need to admit patient in ICU who really deserves most.

The indications for ICU admission vary regionally and even within institutions (Oke., 2001; Unal *et al*., 2015; Dunser *et al*., 2017). The scope of ICU admissions in many LMICs is on the increase with associated mortality based on patient pathology and quality of hospital care (Narayan & Kashuk., 2019). Identifying patients who would benefit from ICU admission is a major challenge in critical care medicine. Patients may die following denied ICU care due to admission of patients with poor prognosis. As a result, ICU admission is indicated for patients with potentially recoverable disease (Nates *et al*., 2016; Blanch *et al*., 2016).

Recently, demand for surgical intensive care is increasing due a number of reasons such as advancement in operative procedures, improved critical care service and critical care technologies (Fowler *et al*., 2019; Kirubel *et al*., 2020).Emergency department, high dependency units or general wards may act as a source for ICU admissions due to deterioration of patients's clinical condition or as a postoperative case from the operating theatre. Failure to awake from anesthesia, surgeries with high risk of complication and various sequalae of procedures are among the reasons of ICU care for a surgical patient (Chalya *et al*., 2011; Fowler *et al*., 2019; Kirubel *et al*., 2020). Surgical patients requiring ICU care originate from a variety of admitting primary services and may require critical care services at any time during their course of illness. This care spectrum can range from routine postoperative monitoring of complex cases to resuscitation to restore normal physiology and correct metabolic acidosis, hypothermia, and coagulopathy (Narayan & Kashuk., 2019).

Despite continued advances in intensive care unit technology and the availability of sophisticated interventions for the treatment of critically ill patients, most of critically ill or severely injured patients continue to die in the ICU (Gunning & Rowan., 1999; Ilori & Kalu., 2012). Identification of factors responsible for this state of affairs is of paramount important in order to improve the outcome of these patients (Ilori & Kalu., 2012). The outcomes in intensive care have primarily been focused on hospital survival and resource utilization adjusted for severity of illness.

Many outcome prediction systems for ICU patients have been developed and are routinely used in many ICU all over the world measuring severity of illness as mortality prediction models (Gunning & Rowan., 1999). They have been widely used and their performance well studied in large international data set. Predicted outcomes may also be used both for clinical decision making in individual patients and for assessing quality of care. Severity of illness of surgical patients in the ICU setting is typically quantified using models relating risk of death to physiologic variables within 24 hours of admission to the ICU (Knaus *et al*., 1985; Gunning & Rowan., 1999; Ilori & Kalu., 2012).The

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APACHE scoring system is widely used in general intensive care units (ICU) for comparative audit, evaluative research, and clinical management of individual patients (Knaus *et al*., 1985).The APACHE II score have been developed and are routinely used in many ICU all over the world measuring severity of illness as outcome prediction models(Knaus *et al*., 1985).

There is a dearth of studies on surgical indications and outcomes of admissions into the ICU in LMICs. To the best of the authors' knowledge, data regarding surgical indications and outcomes in the ICU is well-documented in high income countries (HICs) (), but limited data is available in LMICs. In Tanzania for example, data regarding surgical ICU admissions is limited despite large number of surgical patients admitted to our ICUs, hence the need for this study in a Tanzanian setting. This study was conducted at BMC to describe the indications and treatment outcome of surgical patients admitted to our ICU and to identify predictors of outcome using APACHE II scoring system, a score which have not previously used to evaluate our patients' severity of disease in ICUs. This study will provide updated information about the recent pattern of surgical ICU admission and outcome at BMC and concentrate on areas in need of improvement that will benefit patients admitted for ICU care.

Methods and patients

Study design and setting

This was a descriptive longitudinal study involving surgical patients admitted to the ICU of Bugando Medical Centre from August 2017 to May 2018. BMC is a consultant and a teaching hospital located in Mwanza city in the Lake zone of north-western Tanzania, serving a population of approximately 18 million people (https://www.nbs.go.tz›takwimu›Census 2022 PDF). It is a tertiary care and a teaching hospital for the Catholic University of Health and Allied Sciences (CUHAS). The hospital has a 12-bed adult and 10-bed pediatric multi-disciplinary Intensive Care Unit (ICU) which is headed by 3 anesthesiologists and run by trained ICU nurses. The ICU provides services to all patients (trauma and non-trauma, medical and surgical, obstetric) requiring advanced airway support, mechanical ventilation, hemodynamic support, and electronic monitoring which are usually not available in the surgical high independency unit (SHDU) and normal wards in our hospital. The majority of critically ill patients admitted in the ICU come from the Emergency department (EMD), operating theatre, SHDU, wards and others come from other peripheral hospitals from ICU records.

Study population, sample size estimation, sampling procedure and study variables

The study population included all surgical patients who were admitted to the ICU during the period of this study and those who were willing to participate in the study after signing an informed consent form. Unconscious patients without next of kin to consent for the study were excluded from the study. The minimum sample size of this study was calculated using Yamane Taro (1967) as follows; n=N/1+N (e) 2. Where; n = the sample size; N= the population size = 240 (number of patients admitted in the ICU at BMC in 2016/2017); e = the level of precision = 0.05. The estimated minimum sample size was 150 patients + 10% (loss to follow up) = 195 patients. Convenience sampling was performed to include all patients who met the inclusion criteria within the study period.

All surgical patients admitted in the ICU, either from the emergency department, the operating rooms, or from the surgical HDU and wards were screened for eligibility to participate in the study and those who met the inclusion criteria were enrolled into the study after signing an informed consent to participate in the study. The severity of the illness was measured using the modified APACHE II scoring system. Once in the first 24 hours APACHE II score of every patient was calculated by the principal investigator. The admission APACHE II scores was calculated for all of the patients based on clinical and physiological variables obtained once the patient admitted in ICU as well as their age and information on chronic health status. In the case of sedated patients was still under immediate post-anaesthesia observation, the score relating to the assessment of consciousness level via the Glasgow Scale was calculated only after the patient had recovered from anaesthetic effect. For intubated patients, this score was calculated considering their capacity to understand, regardless of speech. Due to non-availability of facilities for blood gases analysis, this variable was not included in the calculation of admission APACHE II scores, and therefore the severity of the illness was measured using modified admission APACHE II scores.

Standard ICU treatment was given to all the patients admitted. The eligible patients were followed by the duty doctors and charts reviewed on a regular basis from ICU admission till the end point whether death, shifted to the surgical wards or discharged. Post-ICU death was defined as death occurring between ICU discharge and hospital discharge. The decision for discharge from the ICU department was made by the attending physician subjectively when the patient's physiologic status became stabilized (successful weaning from ventilator, no need of ionotropic support, conscious level enough to maintain airway, near normal arterial pH) and ICU monitoring and care were no longer necessary. All patients were discharged to surgical wards for further care.

Data management

Data collection

Data was collected using a pre-coded structured questionnaire. Variables included in the questionnaire were patients' bio-data, clinical diagnosis on admission, post-operative complications, indications for ICU admissions, source of admission/referring unit, history of chronic disease, past hospitalization, past ICU admission, timing of admission, surgical status, state of the patient, ASA physical status, admission hemodynamic parameters, laboratory investigations, APACHE II score, interventions during the first 24 hours when the patient enters the ICU and outcome variables.

Statistical data analysis

Data collected were entered into Ms excel sheet and analyzed using STATA version 15 (College Station, Texas, USA). Data was summarized in form of proportions and frequent tables for categorical variables. Continuous variables were summarized using means with standard deviation or median with interquartile range. P-values was computed for categorical variables using Chi – square ($\chi 2$) test and Fisher's exact test depending on the size of the data set. Independent student t-test was used for continuous variables. Multivariate logistic regression analysis was used to determine predictor variables that are associated with outcome. Post-operative complications were entered into univariate and multivariate analysis after been categorized into presence or absence of post-operative complications. The LOS was arbitrarily be categorized as ≤ 14 days and > 14 days. A p-value of less than 0.05 was considered to constitute a statistically significant difference.

Results

Socio-demographic and clinical characteristics of patients admitted to ICU

Out of the total 357 patients who were admitted to the ICU during the period of study, 199 (55.7%) were surgical patients, of which all were enrolled in the study. Their age ranged from 3 months to 86 years with the median age of 32 [IQR 14 – 45] years. The age group 21-40years had the highest number of admissions accountings for 76(38.4%) patients. There were 124 (62.3%) males and females were 75(37.7%) with a males to female ratio of 1.7:1. Most of patients, 130 (65.0%) were admitted to ICU more than 72 hours after the onset of their illness. The time interval between onset of illness and arrival to the emergency department ranged from 2 hours to 5 days with a median of

22 hours [IQR 20-24] hours. Mean modified APACHE-II score of the study patients was 24.38 ±6.12 [range 12-68]. The majority of patients, 89(44.7%) had modified APACHE-II score of 21-30 (Figure 1). Table 1 below summarizes socio-demographic and clinical characteristics of patients enrolled into the study.

Table 1 Socio-demographic and clinical characteristics of patients admitted to ICU (N=119)

Patient characteristics	Number(n)	Percentage (%)
Age in years		
< 20	60	30.3
21 – 40	76	38.4
41 – 60	42	21.2
>65	21	10.6
Sex		
Male	124	62.3
Female	75	37.7
Duration of symptom		
≤ 1 week	89	44.7
> 1week	110	55.3
Timing of admission		
≤24 hours	30	15.1
24 – 48 hrs	28	14.1
48 – 72hrs	11	11.5
>72 hrs	130	65.3
Systolic Blood Pressure		
< 90	21	13.6
90 – 130	102	65.8
> 130	32	20.7
Temperature		
>37.5	41	20.6
36.0 – 37.5	144	72.4
<36.5	14	7.0
Respiration rate		
>30	14	7.0
10 – 29	185	93.0
Pulse rate		
< 60	3	1.5
>90	125	62.8
60– 90	71	35.7
Heart rate		
60 – 90	137	69.0
>90	62	31.2
SPO_2		
< 90	10	5.0
>90	189	95.0
Glasgow coma score		
< 8	20	10.1
8 – 13	15	7.5
13 – 14	45	22.6
15	119	59.8
American Society of Anaesthesia(ASA)		

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I	39	27.9
II	73	52.1
III	24	17.1
IV	3	2.1
V	1	0.7

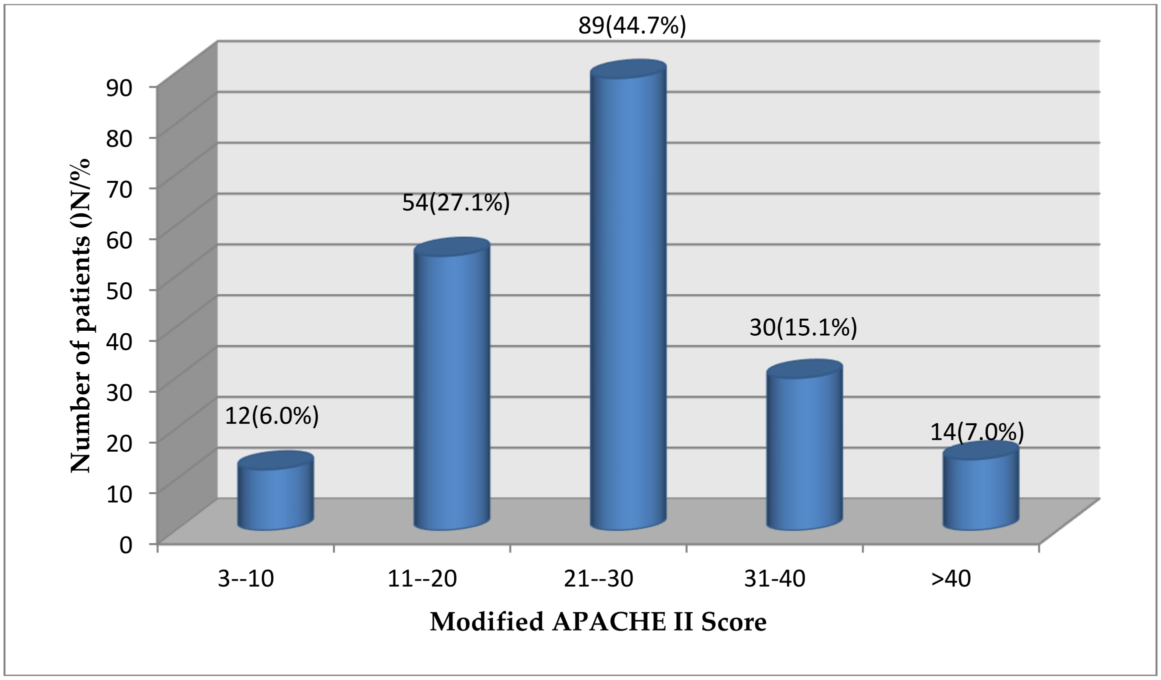

Figure 1: Distribution of patients according to Modified APACHE Score

Admission patterns among surgical patients admitted in the Intensive care unit (ICU)
Of the 199 surgical patients admitted to the ICU, 138 (69.4%) were admitted for observation/close monitoring, where as the remaining 61(30.7%) patients were admitted for mechanical ventilator (Figure 2). The source of ICU admissions were mainly from the Operating Room, EMD and wards in 126 (63.3%), 44(22.1%) and 29 (14.6%) patients respectively. General surgery had the highest number of patients admitted to the ICU accounting for 33.7% of cases as shown in Figure 3 below. Among 67 general surgical patients admitted in the ICU during the study period, peritonitis was the most common cause of admission in 46.8% of cases, whereas the least cause was pethedine over-dosage occurring in 2.1% of cases (Figure 4). Table 2 below shows the diagnoses at admission to the ICU among neurosurgery, cardiothoracic surgery, ENT/Head & neck surgery, internal medicine/ orthopedic and urology specialties. Eclampsia was the most frequent diagnosis at admission among gynecology/obstetric patients admitted to the ICU accounting for 21.1% of cases (Figure 5).

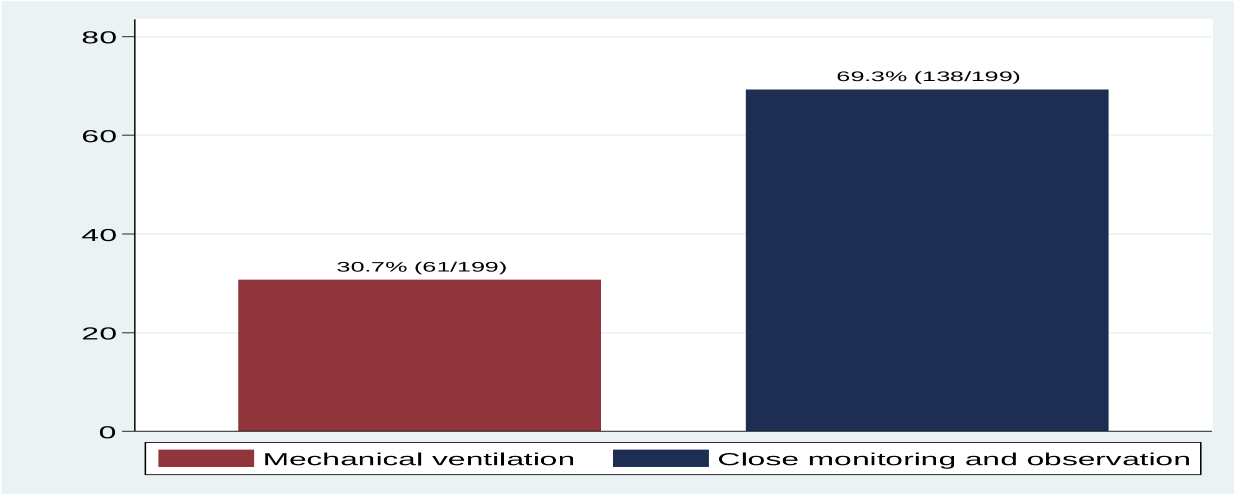

Figure 2: Indications for admissions in intensive care unit among surgical patients (N=199)

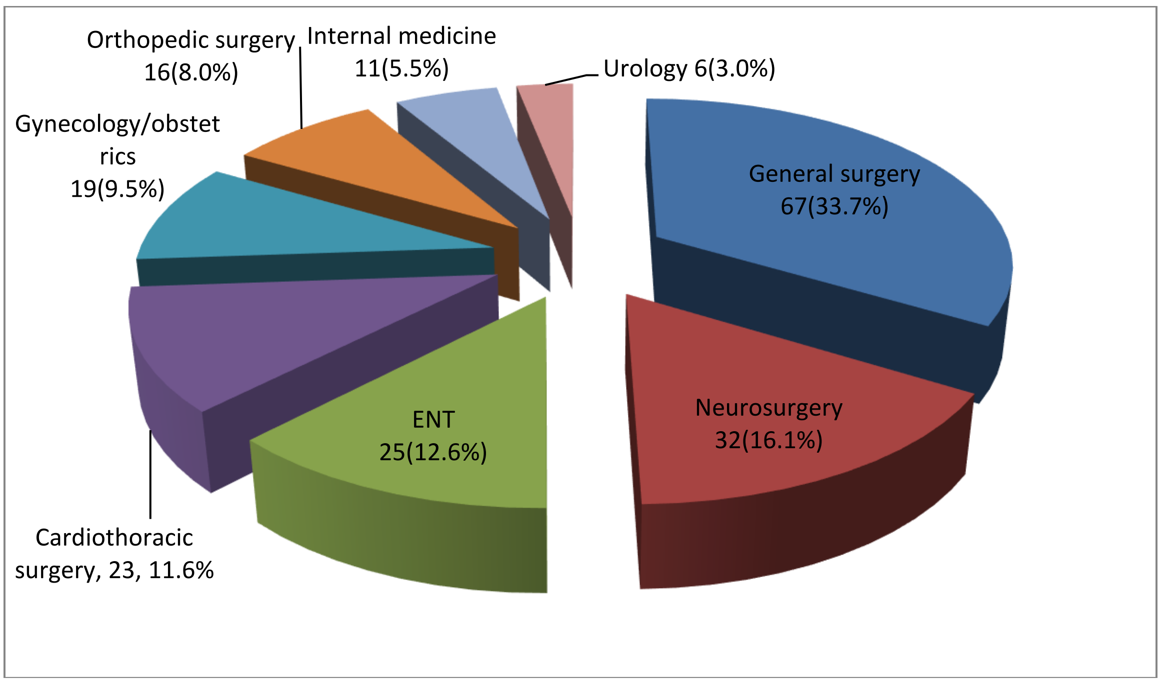

Figure 3: Distribution of the frequency of ICU admissions based on specialties (N=199)

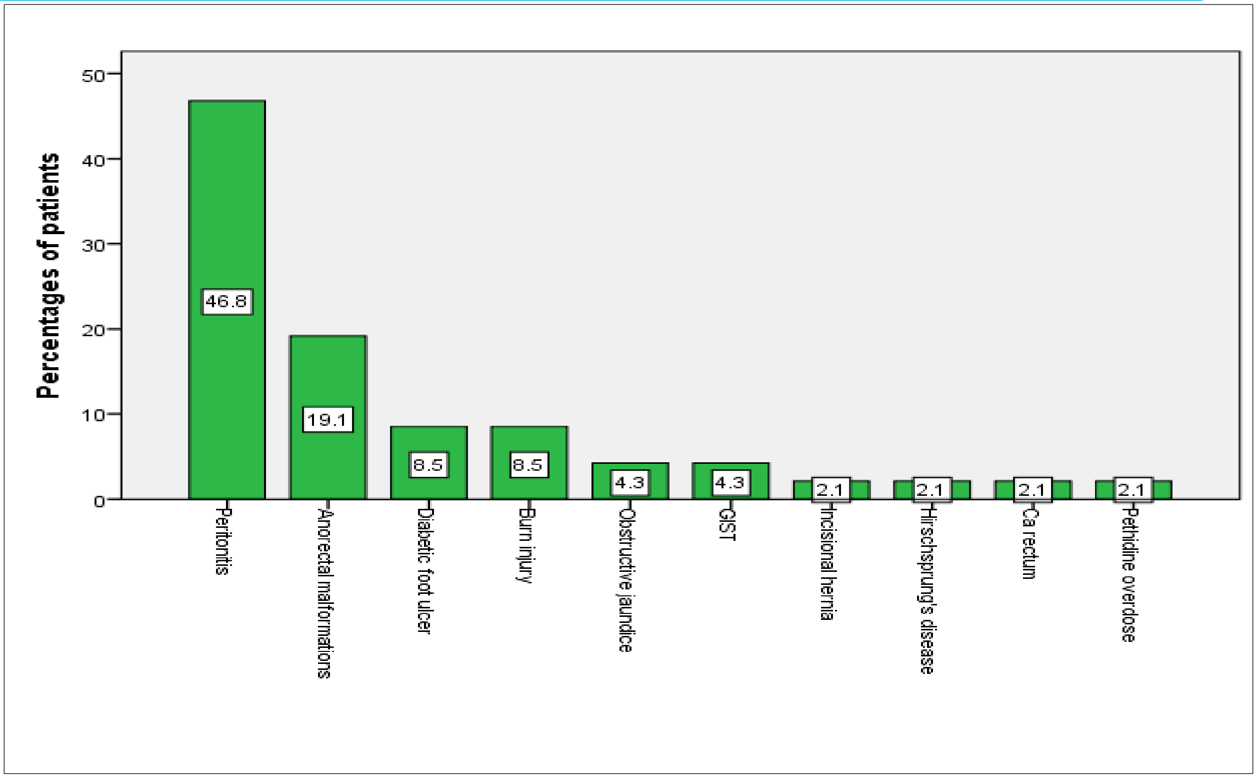

Figure 4: Distribution of patients according to the diagnosis at admission among general surgical patients admitted to the ICU at BMC (N=67)

Table 3: Distribution diagnoses at admission to ICU among neurosurgery, cardiothoracic ENT/Head & neck surgery, internal medicine/ orthopedic and urology specialties at BMC (N=113)

Specialty	Diagnosis	Number of patients	Percentages
Neurosurgery		**32**	**16.1**
	Traumatic brain injury	19	59.4
	Brain tumor	8	25.0
	Spinal injury	3	9.4
	Epidural hematoma	1	3.1
	Hydrocephalus	1	3.1
Cardiothoracic surgery		**23**	**11.6**
	Oesophageal stricture	5	21.7
	Chronic empyema thoracis	4	17.4
	Foreign body in the esophagus	3	13.0
	Pleural effusion	3	13.0
	Lung tumor	2	8.7
	Tension pneumothorax	2	8.7
	Hiatus hernia	2	8.7
	Pericardial effusion	1	4.3
	Multiple rib fractures	1	4.3
ENT/Head & neck surgery		**23**	**11.6**
	Goitres	9	39.1
	Adenoid + tonsillitis	5	21.7

	Glotic foreign body	2	8.7
	Mandibular tumor	1	4.3
	Cleft lip	1	4.3
	Cranial facial fracture	1	4.3
	Long uvula	1	4.3
	Tongue cyst	1	4.3
	Laryngeal tumor	1	4.3
	Ameloblastoma	1	4.3
Urology		**6**	**3.0**
	BPH	3	50.0
	Bladder tumor	2	33.3
	Ureter injury	1	16.7
Internal medicine /orthopedic		**27**	**13.5**
	Polytrauma	16	59.3
	Tetanus	11	42.3

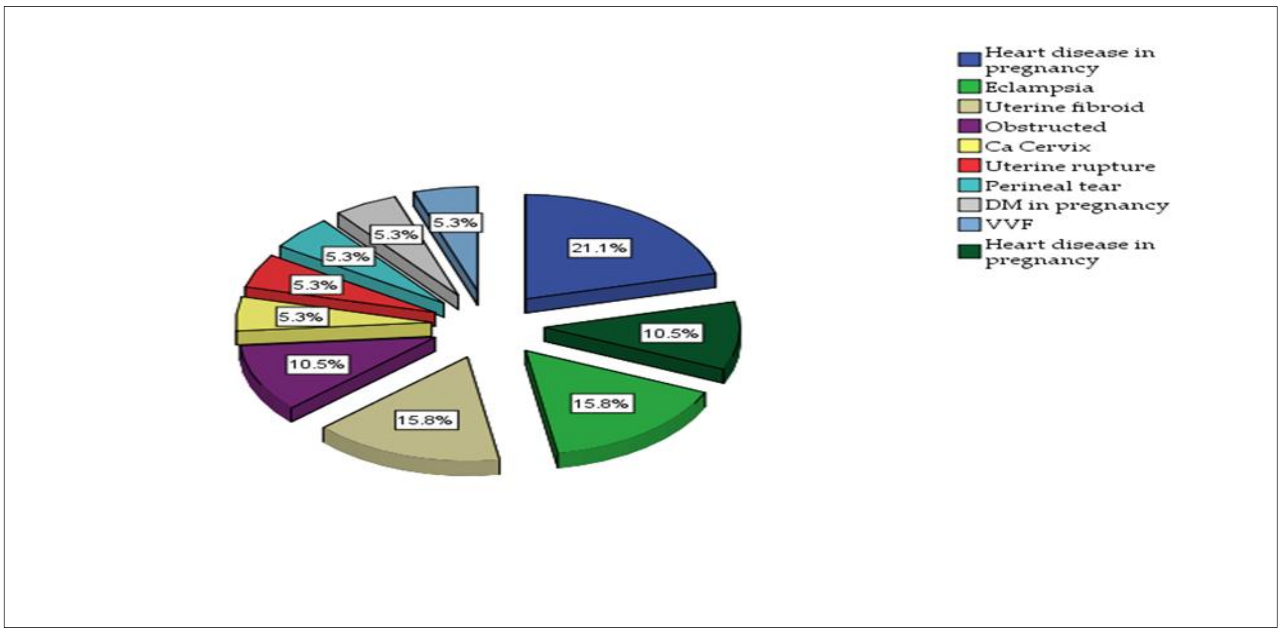

Figure 5: Distribution of patients according to the diagnosis at admission among gynecology/obstetric patients admitted to the ICU at BMC (N=19)

Laboratory findings of patients admitted to ICU

Out of the 199 patients admitted to ICU, 63 (31.7%) had low hemoglobin levels of less than 10 g/dl. Serum creatinine and urea revealed high levels in 90 (45.2%) and 52(26.1%) patients respectively. Electrolytes imbalance revealed low results of serum potassium, sodium and calcium performed in 90 (45.2%), 38 (19.1%) and 1(0.5%) patients respectively (Table 4). Serological test for HIV infection revealed positive results in 15 (7.5%) patients.

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Table 4: Distribution of laboratory findings among surgical patients admitted to ICU (N=199)

Laboratory	Numbers (n)	Percentage (%)
Hb level		
<7	26	13.1
8– 9	37	18.6
>10	136	68.3
Serum creatinine		
<44 umol/l	31	15.6
>80 umol/l	90	45.2
44– 80 umol/l	78	39.2
Urea		
< 2.5mmol/l	56	28.1
>6.5mmol/l	52	26.1
2.5 – 6.5 mmol/l	91	45.7
Potassium		
< 3.5mmol/l	90	45.2
>5.0 mmol/l	15	7.5
3.5 – 5.0	94	47.2
Sodium		
<135mmo/l	38	19.1
>145 mmol/l	30	15.1
135– 145	131	65.8
Calcium		
< 0.5 mmol/l	1	0.5
>3 mmol/l	9	4.5
0.5 – 3 mmol/l	189	95.0

Treatment modalities among surgical patients admitted to the ICU

Out of 199 patients who were enrolled in the study, 134 (67.3%) underwent surgical treatment and the remaining 65 (32.7%) patients were treated conservatively. Continuous monitoring/observation/ administration of oxygen was the most common interventions done in the ICU as shown in Figure 6 below. Of those who underwent surgery, 92 (68.7%) were operated on emergency basis while 42 (31.3%) patients had an elective surgery. Table 6 below shows distribution of patients according to the type of surgical procedures performed.

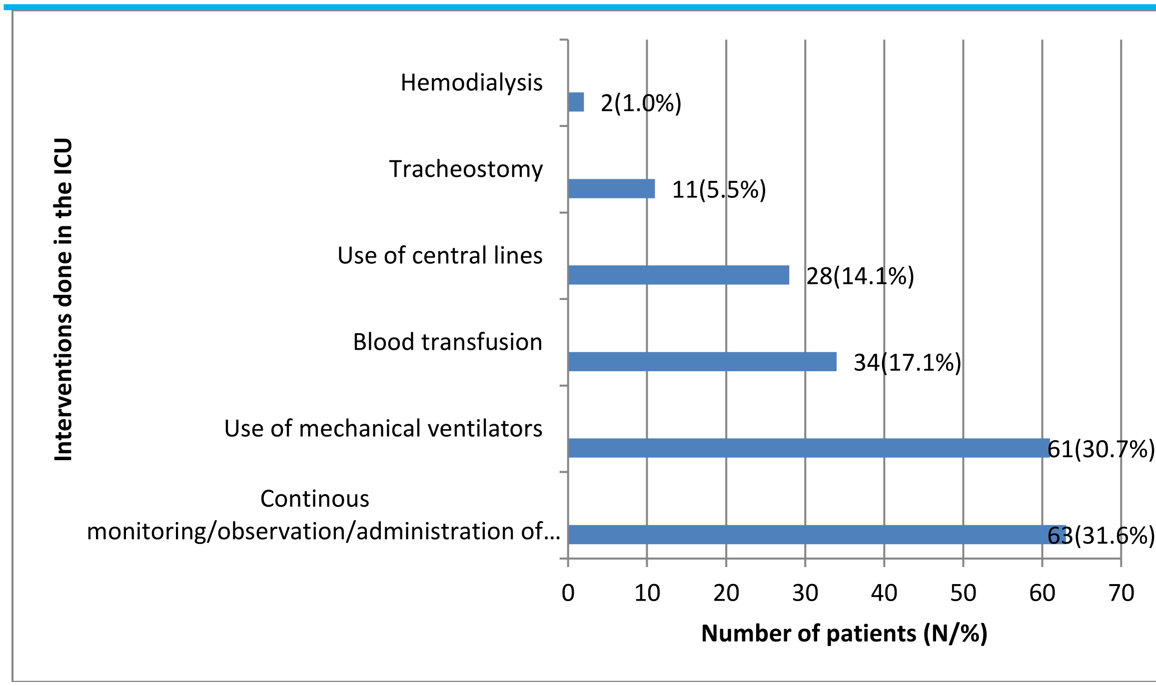

Figure 6: Distribution of patients according to interventions performed in the ICU a BMC (N=199)

Table 5: Distribution of patients according to the type of surgical procedures performed at BMC (N= 134)

Specialty	Surgical procedure	Number of patients	Percentages
General surgery	Laparotomy	24	51.1
	Colostomy	10	21.3
	PSARP	4	8.5
	Limb amputation	4	8.5
	Herniorrhaphy	2	4.3
	Cholecystojejunostomy	2	4.3
	APR	1	2.1
ENT/Head & Neck surgery	Tracheostomy	11	32.4
	Thyroidectomy	9	26.5
	Adenotonsillectomy	5	14.7
	Tumor excision	4	11.8
	Glotic foreign body removal	2	5.9
	Cleft lip repair	1	2.9
	Craniofacial reconstruction	1	2.9
	Ovulectomy	1	2.9
Cardiothoracic	Thoracotomy	7	31.8
	Esophageal dilatation	5	22.7
	UWSD	5	22.7
	Decortication	4	18.2
	Pericardial window	1	4.5
Gynecology/Obstetrics	Cesarean section	8	53.3
	TAH	4	26.7

	Laparotomy	1	6.7
	Perineal tear repair	1	6.7
	VVF repair	1	6.7
Neurosurgery	Craniotomy	8	80.0
	VPS	1	10.0
	Barr holes	1	10.0
Urology	TURP	3	50.0
	Cystectomy	2	33.3
	Ureteric repair	1	16.7

Keys: UWSD= Underwater seal drainage, VPS = Ventriculo-peritoneal shunt, VVF=, TURP =Transurethral resection of prostate, PSARP=, TAH=

Treatment and predictors of outcomes among surgical patients admitted to the ICU

Out of 134 patients who underwent surgery, 66 (49.3%) developed complications, of which electrolyte imbalance was the most frequent postoperative complication accounting for 33(50.0%) patients. Figure 7 below summarizes the distribution of ICU admitted patients according to postoperative complications

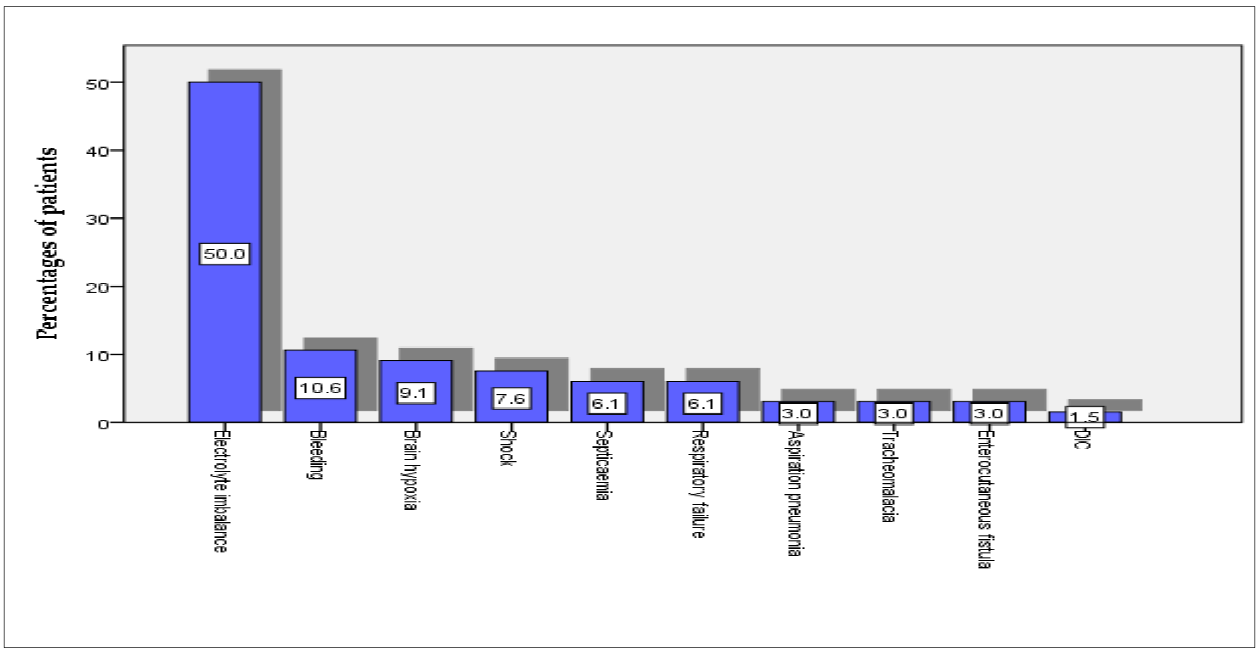

Figure 7: Distribution of patients according to postoperative complications (N=66)

Length of hospital stay among surgical patients admitted in ICU

The overall ICU length of stay (LOS) for all surgical patients ranged from 1 to 186 days (median = 18 days).The median ICU length of hospital stay (LOS) for survivors and non-survivors were 16 and 6 days respectively. These differences were statistically significant (p = 0.012). Of 199 surgical patients, 182 (91.5%) stayed in ICU for two weeks or less whereas 17 (8.5 %) stayed more than two weeks. Figure 8 summaries the length of ICU stay among surgical patients admitted in the ICU.

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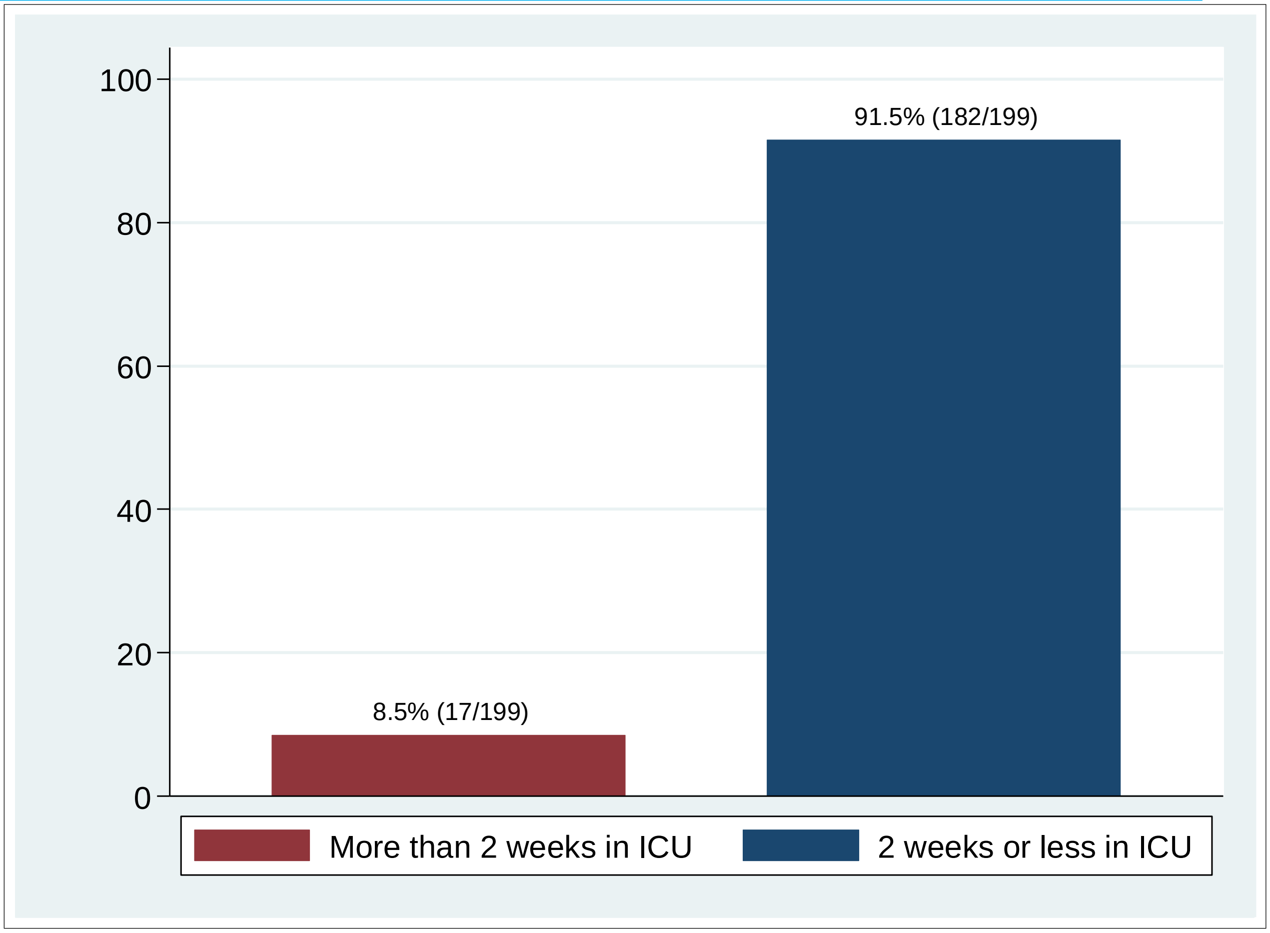

Figure 8: Length of stay among surgical patients admitted in ICU at BMC (N=199)

Multiple logistic regression analysis showed that significant factors predicting longer staying in the ICU were high ASA class (OR= 2.34; 95% CI [1.12-7.98]; *p*= 0.002), emergency surgery (OR= 6.22; 95% CI [2.71-8.33]; *p* = 0.011), higher APACHE score (OR = 0.54; 95%CI [0.11-0.99]; p= 0.014), high temperature (OR = 4.89; 95% CI [2.11-9.77]; p= 0.022) and presence of complications (4.43; 95% CI [1.11-9.43]; p = 0.015).

Out of 199 patents, seventy-eight died giving a mortality rate of 39.2% (Figure 6). Table 6& 7 shows clinical and laboratory predictors of mortality according to univariate and multivariate logistic regression analysis. Analysis of outcome showed that all of 121 (100.0%) survivors were transferred to the wards. No patients were referred to another tertiary institution or left against medical advice.

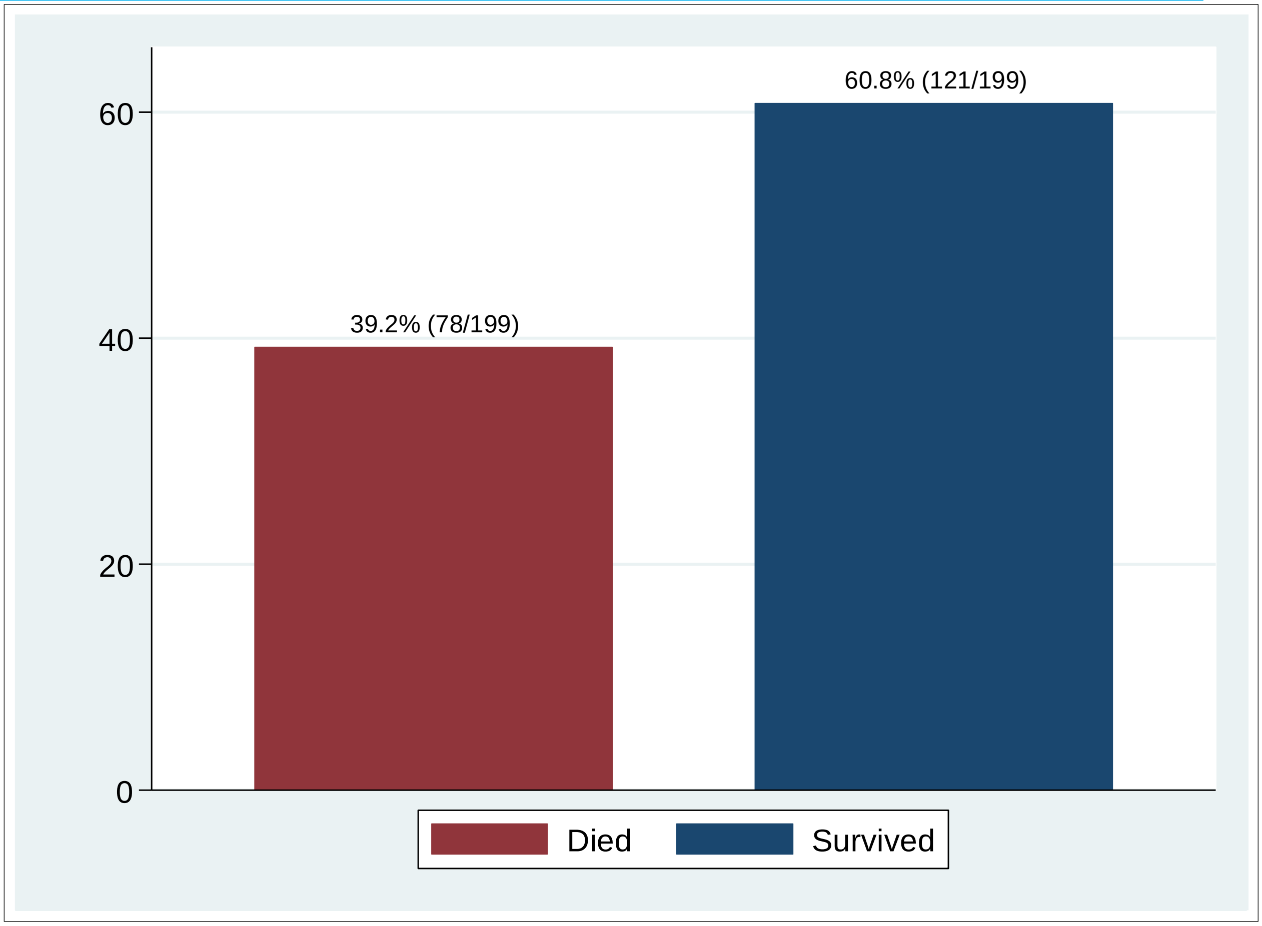

Figure 9: Mortality among surgical patients admitted in ICU at BMC (N=199)

Table 6: Clinical predictors of mortality among surgical patients admitted in ICU at BMC (N=199)

Predictor variables	**Outcome**		**Univariate analysis**		**Multivariate analysis**	
	Non-survivors	**Survivors**				
	n (%)	**n (%)**	**OR [95 CI%]**	**p-value**	**OR [95 CI%]**	**p-value**
Age in years						
< 20	14 (23.3)	46 (76.7)	1.0			
21 – 40	35 (46.1)	41 (54.0)	2.8 [1.3 – 5.9]	0.007	2.0 [0.7 – 5.8]	0.191
41 – 60	18 (42.9)	24 (57.1)	2.5 [1.0 – 5.8]	0.039	3.0 [1.0 – 8.6]	0.047
> 60	11 (52.4)	10 (47.6)	2.6 [1.3 – 10.3]	0.016	6.7 [1.8 – 24.5]	**0.004**
Sex						
Female	26 (34.7)	49 (65.3)	1.0			
Male	52 (41.9)	72 (58.1)	1.4 [0.8 – 2.5]	0.309		
Duration of symptom						
> 1week	32 (29.1)	78 (70.9)	1.0			
≤ 1 week	46 (57.7)	43 (48.3)	2.6 [0.5 – 4.7]	0.091		
Onset on arrival time						
<24 hours	10 (33.3)	20 (66.7)	1.0			
24 -48 hrs	16 (57.1)	12 (42.9)	2.7[0.9 – 7.7]	0.001	2.6 [0.7 – 10.1]	0.159

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48 – 72hrs	3(27.3)	8 (72.7)	0.8[0.2 – 3.5]	0.071	0.6 [0.1 – 3.0]	0.546
>72 hrs	49(37.7)	81 (62.3)	1.2[0.5 – 2.8]	0.656	3.5 [1.0 –11.9]	**0.047**
Systolic Blood Pressure						
90 – 130	42 (41.2)	60 (58.8)	1.0			
< 90	14 (66.7)	7 (33.3)	2.9 [1.1 – 7.7]	0.038	3.1[1.2 – 8 .0]	**0.022**
> 130	15 (46.9)	17 (53.1)	1.3 [0.6 – 2 .8]	0.570	1.4 [0.3 – 6.6]	0.658
Temperature						
36 – 37.5	47 (32.6)	97 (67.4)	1.0			
>37.5	22 (52.7)	19 (46.3)	2.4 [1.2 – 4 .8]	0.016		
< 36.5	9 (69.3)	5 (35.7)	3.7 [1.0 – 11.7]	0.025		
Respiration rate						
10 – 29	70 (37.8)	115(62.2)	1.0			
>30	8 (57.1)	6(42.9)	2.2 [0.7 – 6 .6]	0.162		
Pulse rate						
60 – 90	21 (29.6)	50 (70.4)	1.0			
< 60	1 (33.3)	2 (66.7)	1.2 [0.11 – 3.9]	0.889	4.3[0.3 –3.0]	0.282
>90	56 (44.8)	69 (55.2)	1.9 [1.1 – 3 .6]	0.037	1.6 [0.7 –3.5]	0.285
Heart rate						
60 – 90	62 (45.3)	75 (54.7)	1.0			
>90	16 (25.8)	46 (74.2)	0.4[0.2 – 0 .8]	0.010		
SPO2						
>90	70 (37.0)	119(63.0)	1.0			
≤90	8 (80.0)	2 (20.0)	6.8[1.43 – 2.9]	0.017	8.6 [1.45 – 3.9]	**0.022**
Glasgow coma score						
15	33 (27.7)	86 (72.3)	1.0			
13 – 14	18 (40.0)	27 (60.0)	1.7 [0.8 – 3 .6]	0.132	1.9 [0.8 – 4.6]	0.148
<13	27 (77.1)	8 (22.9)	8.8 [3.6 – 21.3]	<0.001	7.1 [2.3 – 22.2]	**0.001**
Indication for ICU admission						
Monitoring/observ	38 (27.5)	100(72.5)	1.0			
Mechanical ventil	40 (65.6)	21 (34.4)	05.0 [2.6 – 9.6]	<0.001	2.7 [1.2-6.1]	**0.020**
ASA						
1	8 (20.5)	31 (78.5)	1.0			
2	15 (20.6)	58 (79.5)	1.0 [0.4 – 2 .6]	0.997		
3 – 5	18 (64.3)	10 (35.7)	7.0 [2.3 – 20.9]	0.001		
APACHE II Score **<30** **>30**	 46(29.7) 32(72.7)	 109(70.3) 12(27.3)	 1.0 6.7[2.4-12.7]	 0.002	 4.3[1.4-7.9]	 **0.023**
Overall LOS						
< 14 days	71 (39.0)	111(61.0)	1.0			
>14 days	7 (41.2)	10 (58.8)	1.1 [0.4 – 3.0]	0.861		

Table 5 Laboratory predictors of mortality among surgical patients admitted in ICU.

Predictor variables	Outcome		Univariate analysis		Multivariate analysis	
	Non survivors	Survivors				
	n (%)	n (%)	OR [95 CI%]	*p*-value	OR [95CI%]	*p*-value
Hemoglobin level						
>10	53 (39.0)	83 (61.0)	1.0			
8 – 9	15 (40.5)	22 (59.5)	1.0 [0.4 – 2.3]	0.961	-	-
<7	10 (38.5)	16 (61.5)	1.1 [0.5 – 2.2]	0.862	-	-
Serum creatinine						
44– 80 umol/l	28 (35.9)	50 (64.1)	1.0			
<44 umol/l	13 (42.0)	18 (58.1)	1.3 [0.6 – 3.0]	0.558	-	-
>80 umol/l	37 (41.1)	53 (58.9)	1.2 [0.7 – 2.3]	0.489	-	-
Urea						
2.5 – 6.5 mmol/l	27 (29.7)	64 (70.3)	1.0			
< 2.5mmol/l	23 (41.1)	33 (58.9)	1.7 [0.8-3.3]	0.158	1.7[0.8 – 3.8]	0.202
> 6.5mmol/l	28 (53.9)	24 (46.2)	2.8 [1.4-5.6]	0.005	2.7[1.3 – 5.8]	**0.008**
Potassium						
3.5 – 5.0	37 (39.4)	57 (60.6)	1.0			
< 3.5mmol/l	31 (34.4)	59 (65.6)	0.8 [0.4–1.5]	0.490		
>5.0 mmol/l	10 (66.7)	5 (33.3)	3.1 [1.0-9.7]	0.055		
Sodium						
135– 145	53 (40.5)	78 (59.5)	1.0			
<135mmo/l	10 (26.3)	28 (73.7)	0.5 [0.2 -1.2]	0.116	-	-
>145 mmol/l	15 (50.0)	15 (50.0)	1.9 [0.7-3.3]	0.341	-	-
Calcium						
0.5 – 3	72 (37.9)	118 (62.1)	1.0			
>3 mmol/l	6 (66.7)	3 (33.3)	3.3 [0.8-13.5]	0.100		

Discussion

Globally, critically ill surgical patients have been reported to be a major cause of hospitalization and intensive care utilization and consumes a significant amount of the health care budget (Adhikari *et al.*, 2010; Dünser *et al.*, 2017). In this study, surgical patients constituted the majority of ICU admissions accounting for more than a half (55.7%) of all ICU admissions. These results are supported by results of previous studies which also reported that most of the patients admitted to ICU in the developing world were surgical cases (Dünser *et al.*, 2017). The finding of more surgical patients among the ICU admissions in our study may be due to the high rate of postoperative patients that were admitted into our ICU. Considering this growing evidence, there is need for strengthening surgical care in this region to reduce the burden of surgical diseases on critical care services.

In our study, the majority of patients were in the third decade of life and tended to affect more males than females (Chalya *et al.*, 2011; Dünser *et al.*, 2017).The patient population included in this study is younger compared with patients admitted to ICUs in developed countries (Dünser *et al.*, 2017). However, our findings are similar to those reported from surveys of critically ill patients treated in other African countries (Abubakar *et al.*, 2008; Chalya *et al.*, 2011; Dünser *et al.*, 2017), where life expectancy is comparably low to that of Tanzania. Male predominance in the present study does not agree with the earlier finding of Mato *et al* (2009) who found female preponderance in their series. We could not find in literature the reasons for this age and gender differences.

In keeping with previous studies done elsewhere (Size *et al*., 2005; Abubakar *et al*., 2008), observation or close monitoring following surgery was the most common indication for ICU admission in our study. In this study, General surgical specialty including operated and non-operated patients was observed to be the highest surgical specialty utilizing the ICU bed spaces in our study. This was different from the study done by Mato *et al(*2009*)* where the Obstetrics department was the highest specialty utilizing the ICU bed space. Abubakar *et al* (2008) reported that trauma related cases constitutes the most common disease entity responsible for admission into the ICU in their study. This finding was contrary to the earlier study conducted in the same centre seven years ago by Chalya *et al* (2011) where they reported that trauma was the most common indication for admissions into ICU. Poluyi *et al* (2016) in Nigeria reported that neurosurgical specialty was observed to be the highest surgical specialty utilizing the ICU bed spaces. This observation reflects differences in disease pattern between different study settings.

ICU admission has been reported to be the most important factor in determining the ultimate outcome of critically ill patients (Su *et al*., 2008). As reported by other authors in developing countries (Abubakar *et al*., 2008; Chalya *et al*., 2011; Dünser *et al*., 2017), approximately two thirds of patients in this study were admitted to the ICU late with critical condition. The higher incidence rate of delayed admission to the ICU in developing countries like Tanzania is best explained by the challenges in health related transportations, ignorance, poverty, lack of medical awareness and lack of bed space in the ICU (Size *et al*., 2005; Chalya *et al*., 2011). This delayed ICU admission increases morbidity and mortality many-folds, as is evident from our results. Our study has demonstrated an association between delay to ICU admission and higher mortality rate reflecting worsening of organ dysfunction during this period. Despite the care provided by ward healthcare workers while patients were waiting for ICU bed availability, these healthcare providers were not trained in critical care and are not as experienced in caring for ICU patients. Furthermore, hospital wards are neither designed nor staffed to provide extended longitudinal care for the critically ill patient. These patients have better outcomes when treated in ICUs with close and continuous involvement by critical care physicians (Chalfin *et al*., 2007) and other data also show improved outcome when nurse-to-patient ratios in the ICUs are properly maintained(Young *et al.*, 2003). Caring for critically ill patients outside the ICU may also imply an increased burden and high stress level experienced by hospital wards staff (Freeman *et al*., 2001).

In agreement with other studies(Size *et al*., 2005; Chalfin *et al*., 2007; Chalya *et al*., 2011) , this study has shown that the commonest mode of intervention in the ICU was the administration of oxygen and continuous monitoring of the patients. Unfortunately, we had challenges with monitoring of patient blood gases due to non-availability of appropriate facilities. Meanwhile, most of our patients were admitted into the ICU for the purpose of better monitoring. In the developed World, the indications for ICU admissions and interventions are quite different from the findings of our study (Chalfin *et al*., 2007) . Tracheostomy was performed in 5.5% of patients who had acute upper airway obstruction/failed intubations during resuscitation and for those who required prolonged endotracheal intubation. The been estimated that between 2% and 11% of ICU patients requiring mechanical ventilation in ICU would receive a tracheostomy (Engoren *et al.*, 2004) Obviously, tracheostomy is an important procedure for securing a functional and safe airway in patients with various medical and surgical disease conditions (Kollef *et al*., 1999). It has also been found to be the commonest surgical procedure in the ICU in most centers(Freeman *et al.*, 2001) .

In this study, HIV seroprevalence was found to be 7.5%, a figure that is higher than that in the general population in Tanzania (5.3%)(Tax *et al.*,2015) . However, failure to detect HIV infection during window period may have underestimated the prevalence of HIV infection among these patients. We could not establish the reasons for the high HIV seroprevalence among ICU admissions in our study although it is possible that these patients have an increased risk of exposure to HIV infection. This calls for a need to research on this observation. The finding of high HIV seroprevalence among ICU in our study calls for routine HIV screening in these patients.

The presence of complications has an impact on the outcome of patients admitted to the ICU. In this study, the overall complication rate was found to be 49.3%, a figure which is higher than that reported by other authors (Abubakar *et al*., 2008; Chalya *et al*., 2011). The reason for the high overall complication rate in this study may be attributed to late presentation as a result of the majority of patients came to hospital in poor general condition requiring ICU admission.

The length of stay in ICU has been sounded to a good reflection of the severity of the patient's illness and the health status of the patients as well as the quality and performance. Our figures for the overall median duration of hospital stay in the present study was 18 days, which is higher compared to what is reported in other studies (Abubakar *et al*., 2008; Chalya *et al*., 2011). Factors that predicted longer LOS among ICU admissions in our study were high ASA class, emergency surgery, higher APACHE score, high temperature and presence of large number of patients with postoperative complications. However, due to the poor socio-economic conditions in Tanzania, the duration of inpatient stay for our patients may be longer than expected. In this study, survivors had a statistically significant longer LOS than non-survivors which is in agreement with other studies in developing countries (Amanor-Boadu *et al*., 2003) , but contrary to studies in developed countries which reported non-survivors staying longer and consuming more resources than survivors (Nakamura *et al*., 1999). This difference in survival is probably due to a combination of factors including severity of illness, lack of emergency medical services, and lack of appropriate diagnostic and therapeutic facilities including drugs for the care of these patients in the hospital and the ICU. These factors have been adequately addressed in developed countries.

In the present study, the mortality rate was 39.2%. This figure compares favorably with previous studies in Nigeria which showed overall mortality rates ranging from 30-37.6% (Abubakar *et al*., 2008; Dünser *et al*., 2017); it is higher than those reported in the developed world, where mortality figures of 18-24% have been quoted(De Jonge et ai., 2003; Moran et al., 2008).A low mortality rate of 24.3% was observed by Mato *et al.* (2009) but in their study over 42% of admissions into the ICU was non-justifiable as most patients were admitted into ICU for lack of bed space in the general wards and for better comfort. The high mortality rate in this study was attributed to advanced age > 65 years, delayed ICU admission (> 72 hours), admission systolic BP (< 90 mmHg), PaO2 < 90, need for ventilatory support, high admission modified APACHE II score and high serum urea (>6.5 mmol/l). Addressing these factors responsible for high mortality in our patients is mandatory to be able to reduce mortality in our ICU.

Staffing constitutes the greatest challenge to our intensive care unit. With only one Consultant Anesthetist and a few supporting staff, our facility falls below the international standard of one intensive care nurse/bed/shift. A more intensive staffing produces higher quality of care with a high intensity physician staffing in ICUs resulting in lower mortality and shorter hospital and ICU stays (Pronovost *et al*., 2002). There is an urgent need for training of more staff. Provision of appropriate facilities for monitoring of patient blood gases and other facilities such as a mini dialysis unit besides the main hospital unit and a dedicated ICU side laboratory will also increase the value of ICU care.

The potential limitation in this study is that it is a single institution study, which may not reflect the general perception of ICU outcome in the country and sub-region; therefore, a multicenter study is advised. However, despite this potential limitation, findings from this study provide local data that can be utilized to improve the intensive care of critically ill patients in our local setting. The challenges identified in the management of critically ill patients admitted to the ICU in our setting need to be addressed to deliver optimal care for these patients

In conclusion, the results of this study show that postoperative general surgical patients admitted for observation or close monitoring following surgery was the most common indication for ICU admission. High ASA class, emergency surgery, higher APACHE score, high temperature and presence of postoperative complications were the main factors that predicted longer LOS among ICU admissions in our study. The overall ICU mortality was significantly high and it was associated with factors such as advanced age, delayed ICU admission, admission systolic BP < 90 mmHg, PaO2 < 90, need for ventilatory support, high admission modified APACHE II score and high serum urea levels. It was therefore recommended that:-

- The recovery room and surgical high dependency unit of BMC should be well equipped with modern facilities for care of the critically ill postoperative patients to reduce the number of ICU admissions just for observation
- Factors responsible for prolonged LOS and high mortality in our patients should be addressed to be able to improve the outcome of these patients.
- A well-equipped intensive care unit which greatly facilitates the care of the critically ill patients is a desirable, relevant and vital component to a successful practice in this region
- The results of this study calls for the strengthening of ICU in order to optimize positive patient outcomes

Ethical considerations

The ethical approval to conduct this study was sought from the Joint CUHAS-Bugando/BMC Research Ethics and Review Committee (ethical clearance number CREC/254/2017). Permission to conduct the study was obtained from the hospital authority (BMC). Enrolled patients were required to sign a written informed consent for the study and HIV testing. Patients were assured that the information collected will be maintained under strict confidentiality.

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References

Abubakar, A.S., Ojo, E., El-Nafaty, A., Edomwonyi, N. (2008) An audit of one-year intensive care practice in a developing country. *The Internet Journal of Anesthesiology*18, 2.

Adhikari, N.K., Fowler, R.A., Bhagwanjee, S., Rubenfeld, G.D. (2010) Critical care and the global burden of critical illness in adults. *The Lancet* 376, 339-46.

Amanor-Boadu, S., Sanusi, A., Oyeleke, S., Soyannwo, O.A. (2003) Intensive Care for Trauma Victims in a Developing Country: Priorities and Challenges for Improvement. *African Jounal of Trauma* 1, 51-3.

Blanch, L., Abillama, F.F., Amin, P., Christian, M., Joynt, G.M., Myburgh, J., Nates, J.L., Pelosi, P., Sprung, C., Topeli, A., Vincent, J.L. (2016)Triage decisions for ICU admission: report from the Task Force of the World Federation of Societies of Intensive and Critical Care Medicine. *Journal of Critical Care* 36, 301-5.

Chalfin, D.B., Trzeciak, S., Likourezos, A., Baumann, B.M., Dellinger, R.P. (2007) Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. *Critical Care Medicine* 35, 1477-83.

Chalya, P.L., Gilyoma, J.M., Dass, R.M., Mchembe, M.D., Matasha, M., Mabula, J.B.,Mbelenge, N., Mahalu, W. (2011) Trauma admissions to the intensive care unit at a reference hospital in Northwestern Tanzania. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 19, 61.

De-Jonge, E., Bosman, R., Van- Der Voort, P., Korsten, H., Scheffer, G., De-Keizer, N. (2003) Intensive care medicine in the Netherlands, 1997-2001. I. Patient population and treatment outcome. *Nederlands Tijdschrift Voor Geneeskunde* 147, 1013-7.

Dünser, M.W., Towey, R.M., Amito, J., Mer, M. (2017) Intensive care medicine in rural sub- Saharan Africa. *Anaesthesia* 72, 181-189

Engoren, M., Arslanian-Engoren, C., Fenn-Buderer, N. (200) Hospital and long-term outcome after tracheostomy for respiratory failure. *Chest* 125, 220-7.

Fowler, A.L., Cullivan, O., Sibartie, S., O'Shea, A., Waldron, R., Khan, I., Khan, W. (2019) Barry KM. Utilisation of critical care services for surgical patients in a model three hospital. *Irish Journal of Medical Science* 188, 1137-42.

Ghaffar, S., Pearse, R. M., Gillies, M. A. (2017) ICU admission after surgery: Who benefits?. Curr. Opin. Crit. Care. 23, 424–429

Goldwasser, R.S., Lobo, M.S., Arruda, E.F., Angelo, S.A., Silva, J.R., Salles, A.A., et al. (2016) Difficulties in access and estimates of public beds in intensive care units in the state of Rio de Janeiro. *Rev Saude Publica* 50, 19.

Gunning, K., Rowan, K. (1999) Outcome data and scoring systems. *British Medical Journal* 319, 241.

Idowu, O.E., Oyeleke, S.O., Olaoya, A.A. (2010) Neurocritical Care Audit in A Tertiary Institution. *East and Central African Journal of Surgery* 15, 130-134.

Ilori, I.U., Kalu, Q.N. (2012) Intensive care admissions and outcome at the University of Calabar Teaching Hospital, Nigeria. *Journal of Critical Care* 27, 105.

Kirubel, A., Tesfaye, N., Fitsum, A. (2020) Surgical Admissions and Treatment Outcomes at a Tertiary Hospital Intensive Care Unit in Ethiopia: A Two-Year Review. *Ethiopian Journal of Health Science* 30, 725.

Knaus, W.A., Draper, E.A., Wagner, D.P., Zimmerman, J.E. (1985) APACHE II: a severity of disease classification system. *Critical Care Medicine* 13, 818-29.

Kollef, M.H., Ahrens, T.S., Shannon, W. (1999) Clinical predictors and outcomes for patients requiring tracheostomy in the intensive care unit. *Critical Care Medicine* 27, 1714-20.

Marshall, J.C., Bosco, L., Adhikari, N.K., Connolly, B., Diaz, J.V., Dorman, T, et al. (2017) What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. *Journal of Critical Care* 37, 270-276

Moran, J.L., Bristow, P., Solomon, P.J., George, C., Hart, G.K., Australian, et al. (2008) Mortality and length-of-stay outcomes, 1993–2003, in the binational Australian and New Zealand intensive care adult patient database. *Critical Care Medicine* 36, 46-61.

Murthy, S., Adhikari, N.K. (2013) Global health care of the critically ill in low-resource settings.*Annals of the American Thoracic Society* 10, 509-13.

Nakamura, T., Nishimura, M., Okada, Y., Miyoshi, E., Kono, Y., Ohashi, Y., et al. (1999) Evaluation of mortality of patients admitted to ICU for the last 12 years. Masui *The Japanese Journal of Anesthesiology* 48, 1332-6.

Narayan, M., Kashuk, J.L. (2019). Admission/Discharge Criterion for Acute Care Surgery Patients in the ICU: A General Review of ICU Admission and Discharge Indications. In: Picetti, E., Pereira, B., Razek, T., Narayan, M., Kashuk, J. (eds) Intensive Care for Emergency Surgeons. Hot Topics in Acute Care Surgery and Trauma. Springer, Cham. https://doi.org/10.1007/978-3-030-11830-3_1

Nates, J.L., Nunnally, M., Kleinpell, R., Blosser, S., Goldner, J., Birriel, B., Fowler, C.S,, Byrum, D., Miles, W.S., Bailey, H., Sprung, C.L. (2016) ICU admission, discharge, and triage guidelines: a framework to enhance clinical operations, development of institutional policies, and further research. *Critical Care Medicine* 44, 1553-602.

Oke, D.A. (2001) Medical admission into the intensive care unit (ICU) of the Lagos University Teaching Hospital. *Niger Postgraduate Medical Journal* 8, 179-182

Pronovost, P.J., Angus, D.C., Dorman, T., Robinson, K.A., Dremsizov, T.T., Young, T.L. (2002) Physician staffing patterns and clinical outcomes in critically ill patients: a systematic review. *JAMA* 288, 2151-62.

Sawe, H.R., Mfinanga, J.A., Lidenge, S.J, Mpondo, B.C., Msangi, S., Lugazia, E., Mwafongo, V., Runyon, M.S., Reynolds, T.A. (2014) Disease patterns and clinical outcomes of patients admitted in intensive care units of tertiary referral hospitals of Tanzania. *BMC International Health and Human Rights* 14, 26.

Singh, V., Datta, R., Sasidharan, S., Tomar, L. (2020) Spectrum of postoperative admissions in the intensive care unit of a tertiary care hospital: An Indian update. *Saudi Critical Care Journal* 4, 96-102

Su, Y-Y., Li, X., Li, S-J., Luo, R., Ding, J-P., Wang, L, et al. (2009) Predicting hospital mortality using APACHE II scores in neurocritically ill patients: a prospective study. *Journal of Neurology* 256, 1427-33.

Unal, A.U., Kostek, O., Takir, M., Caklili, O., Uzunlulu, M., Oguz, A. (2015) Prognosis of patients in a medical intensive care unit. North Clin Istanb 2, 189-195.

Young, M.P., Gooder, V.J., Bride, K., James, B., Fisher, E.S. (2003) Inpatient transfers to the intensive care unit. *Journal of General Internal Medicine* 18, 77-83.