A CROSS-SECTIONAL STUDY ON CHALLENGES OF INTRAHOSPITAL TRANSPORT OF CRITICALLY ILL PATIENTS TO KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNITS.

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DISSERTATION PROPOSAL SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD OF THE DEGREE OF MASTERS IN ANAESTHESIA.

DECLARATION

Principal investigator

I declare that this dissertation is my original work, which has never been submitted for a degree in any other University.

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DEDICATION

I dedicate this dissertation to the entire Samoei family, for their support and persistent encouragement. They have also supported me financially and taught me to be patient and work hard to achieve my goals.

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My foremost gratitude goes to the Almighty God for the gift of life, good health, and strength to do this work.

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LIST OF ABBREVIATIONS

ASA…….American Society of Anesthesiologists

CCU ……Critical Care Unit.

ECG……Electrocardiogram

ED….....Emergency department

ERC ….....Ethics and Research Committee.

FiO2……Fractional inspired oxygen concentration.

ICU…….Intensive Care Unit

IHT…….Intra-hospital transport

ITU…….Intensive Therapy Unit

KNH……Kenyatta National Hospital

LAR…….Legally Authorized Representative

NICU……Neonatal Intensive Care Unit

PICU….....Pediatric Intensive Care Unit

SaO2….....Arterial Oxygen Saturation

SPSS……Statistical Package for the Social Sciences

UON….....University of Nairobi

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OPERATIONAL DEFINITIONS

APACHE II score (Acute Physiology and Chronic Health Evaluation II score) is a scoring system designed to measure the severity of disease in patients admitted to the intensive care unit.

A legally authorized representative (LAR): An individual or judicial, or other body authorized under applicable law to grant permission on behalf of a prospective participant for their participation in research activities.

Minimum risk: means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

Minor adverse events: This refers to a 20% decline in the physiologic state in comparison to the patient's status before the transfer

Serious adverse events: These are life-threatening events that require very urgent intervention.

ABSTRACT

Background: Intra-hospital transport of critically ill patients is unavoidable and is associated with an increased risk of adverse events.[1] In 1970, intra-hospital transport (IHT) was first documented and published as potentially dangerous when 84% of transported patients with a high risk of cardiovascular events developed arrhythmias.[2]

Objective: To establish the challenges during IHT of critically ill patients to KNH CCUs.

Methodology: This was a cross-sectional study of the IHT of critically ill patients into KNH CCUs. The study was carried out in the KNH 4 CCUs over a period of 14 weeks. The study participants were 335 service providers involved in the transfer of critically ill patients already admitted to KNH and required admission into the KNH CCUs. Data was collected using a self-administered questionnaire filled by the transport team leader. It was then entered and analyzed by the use of SPSS version 21 and the findings presented in the form of tables, pie charts, and graphs.

Results: The mean age of the patients evaluated was 31.1 years. The majority of the transports to the CCUs come from the operating theatres 125 (37.3%). A dedicated emergency trolley was absent during the transfer of all the critically ill patients though the transport teams carried different equipment and drugs. A total of 231 (69%) transports had patient systemic events involving the cardiovascular, respiratory and the central nervous system. There were no adverse outcomes reported. Equipment failure was recorded in 138 (42.5%) transports.

Conclusions: KNH lacks dedicated transport teams and transport equipment for IHT of critically ill patients. Most of the transports were poorly monitored and transport teams were not well equipped with the basic resuscitation drugs and equipment for emergencies. The transports were hindered in most of the time by the crowded busy corridors and the hallways.

1.0 INTRODUCTION

Critically ill patients are those that present with altered physiological status and more than one life-threatening organ failure, which might lead to significant morbidity or mortality. These patients require comprehensive, specialized care and constant monitoring in intensive care units (ICUs). An ICU or Critical Care Unit (CCU) also known as Intensive Therapy Unit (ITU) is a specialist department of a hospital or healthcare facility with specialized medical equipment where critically ill patients are treated and intensively monitored by a specially trained staff.[3][4]

Intra-hospital transport (IHT) is the movement of the patients within a hospital from one department to the other either for diagnostic or therapeutic interventions. Intra-hospital transport of critically ill patients is unavoidable and is routinely carried out in most healthcare settings. It is associated with a high risk of complications.[5] The primary goal is to provide the safest level of care, and monitoring during transport. [6][7][8][9] In 1970, IHT was recorded and published first as potentially dangerous when 84% of transported patients with a high risk of cardiovascular events developed arrhythmias.[2] Several studies did, later on, reported variation in the incidence, depending on the definition of the adverse events studied, and it ranged from 1.7% to 75.7%. [1][10][11][12][13][14][3][5] They were either directly or indirectly related to the patient, equipment, staffing and the hospital environment. [15]

In an audit by Lovell et al., complications were reported in 62% of 97 cases of IHT of critically ill patients. 45% of these complications were due to equipment and transport environment factors, e.g., battery failure, disconnections, and malfunction. On the other hand, 31% of these were patient-related, e.g., hemodynamic instability, significant ECG changes, desaturation, increased intracranial pressure, and agitation.[13] The purpose of this study is to establish the current practice in KNH and compare to recognized safety standards.

2.0 LITERATURE REVIEW

Critically ill patients are at risk of clinical deterioration. These can occur in the wards, clinics, operating rooms or accident and emergency department and hence may require transport and admission to critical care units. Monitoring and organ support should be continued while in transit to ICU. [16] The ICU is the ideal setup for the care and management of the critically ill patient. There are many risk factors related to the transport equipment, transport team and the organization infrastructure contributing to adverse events during the transport process. [13][17][18][19][20]

Intra-hospital transport equipment and monitoring

Intra-hospital transport should be carried out in a manner that still provides the safest and adequate monitoring using the minimum amount of equipment due to the limitation of space. Intra-hospital transport aims to provide safe transfer of critically ill patients from the transferring unit to the receiving unit by ensuring that there is a continuity of care, constant monitoring, and interventions made whenever necessary. [18] Continuous monitoring throughout the transport process is essential to prevent adverse changes and a further reduction in the physiological reserves. [19][21] The minimum standards for monitoring during intra-hospital transport of critically ill-patients include continuous oxygen saturation (SaO2)[22], electrocardiogram (ECG)[23], non-invasive blood pressure, respiratory rate, and heart rate. Other supplementary monitoring modalities like capnography [24][25] and invasive monitoring for arterial blood pressure[26], central venous pressure (CVP), pulmonary artery pressure and intracranial pressure can be done depending on the patient's clinical status. [8][26][27] Oxygen supply, the fraction of inspired oxygen (FiO2) and airway pressures in ventilator settings are monitored in all mechanically ventilated patients. [21] Most equipment-related adverse events are in the form of disconnection, intrinsic failure/ malfunction or power

supply failure. Malfunction of suction apparatus in the event of accidental extubation during transport process can lead to catastrophic outcomes which may worsen the patient's physiological status. [14][5][28][29][30]

In a prospective study by Damn et al., the analysis of 123 IHTs involving 64 ventilated patients showed around 22% adverse events associated with portable ventilators. These included failure or defect of the ventilator, oxygen or electrical failure and oxygen disconnection. They were attributed to inadequate understanding of the operation of the portable ventilators and inaccurate ventilator settings. [31] Beckmann et al also demonstrated 39% incidence of equipment related critical events in 191 IHTs involving 176 ICU patients. Airway-related adverse events included endotracheal tube obstruction, malposition, and accidental extubation. On the other hand, ventilation related events included inadequate oxygen supply and inaccurate mechanical ventilator settings. These led to 31% serious adverse events resulting in 4 deaths (2%) [19]. In 2007, Papson also reported a 69.7% incidence of adverse events during intra-hospital transport of patients from the emergency department. 45.9% of cases were associated with ventilation and artificial airway while 25.8% were related to tangles and disconnection of tubes, and drainage or monitoring lines.[12]

In a study by Gillman to determine the incidence, nature of adverse events and delay to patient transfer from the emergency department to ICU, the rate of adverse events was estimated at 22%. 9% of these events were related to intrinsic equipment failure while 4.5% were related to power supply failure (uncharged batteries). This resulted in cardiorespiratory arrest due to hypoxia and dysrhythmias (atrial fibrillation, ventricular fibrillation, and asystole).[32]

According to a study by Smith I et al., in 125 transported ventilated and non-ventilated patients, 34% of the complications were related to monitoring processes like ECG lead disconnection, monitor power failure, intravenous line mishaps, drug infusion pump disconnection and ventilator disconnection [33]. The displays of all monitors, ventilators and syringe pumps should be made accessible and visible to escorting staff to reduce these difficulties.[21] The patient's general condition, progress, and management during transport documented and filed in the patient's medical record and copies provided to the receiving unit. [8][21][34]

Equipment related events can be minimized through a pre-transport check, resetting of physiologic alarm limits and regular calibration. Power failure can be minimized by the use of long-lasting lithium batteries, low battery alarms, and connecting equipment to the power source as soon as possible.[8][35][36] Adapted transport equipment with parts for safeguarding lines and leads should be used to prevent tangles and knots during the transport process.

Patient-related factors affecting intra-hospital transport

Critically ill patients are at high risk of physiological deterioration during intra-hospital transport due to both minor and severe incidents from equipment, patient, and environment-related factors.[33] Minor events refer to a 20% decline in the physiologic state in comparison to the patient's status before transfer while serious incidents are those life-threatening cases which require very urgent intervention such as cardiac arrest.[5] The incidence of severe adverse events is 68% with 4.2-8.9% of events requiring immediate therapeutic intervention.[12][5][32] Various studies report a cardiac arrest event amongst 0.34-1.6% of these patients.[12][5][31][32][37] Lahner established that there is a correlation between the minor adverse events and the severity of the patient illness as assessed by APACHE II score; however, there was no association found with severe adverse

events. On the contrary, the global adverse events incidence was significantly increased especially when the transport process was done in an emergency context rather than in an elective manner. [5] According to Papson et al., serious adverse events are due to the severity of the patient clinical condition. [12]

Most systemic events encountered during intra-hospital transfer are related to cardiovascular[2], respiratory and central nervous system. Cardiovascular complications include severe hemodynamic disturbances like arrhythmias, hypotension or hypertension which are preventable with prior resuscitation and stabilization before initiating the transport process. [38] Beckmann's study reported that 42.5% of adverse events like severe hypotension, arrhythmias, declining neurological status, and increased intracranial pressure in head injury patients happen during transport process in an emergency setting when the patient's illness is rapidly deteriorating.[12][19]

Intra-hospital transport team

The transport team plays a crucial role in patients transfer and should consist of at least a qualified trained nurse and a medical practitioner. [35] They require knowledge on the management of the critically ill patient and requisite skills on transport to provide the quality and the safest level of care during intra-hospital transport.[16][21] Risk evaluation must be done before transfer to determine the level of anticipated risks. The assessment should focus on the medical history, current clinical illness and any relevant information which may directly or indirectly worsen patient condition during transfer. These will help to determine the competencies of the transport team needed to escort the patient during transfer. [21] The chain of responsibility for the transport team must be more transparent throughout the transfer period. [39] They should be taught to foresee and handle any potential unexpected events, either medical or technical, during the transfer.[27]

Human errors contribute to 54% of the incidents. These are due to inexperience, errors of judgments, poor problem recognition, inattention, failure to observe protocols, and inadequate preparation of patients and transport equipment. The use of pre-transfer checklist on the patient and equipment and provision of the highly qualified and experienced staff were essential in mitigating these incidents.[19]

According to Bellingan et al., 2000, specialized transport teams involving an ICU-trained doctor (intensivist), nurse and technicians compared to junior doctor provide better care and considerably improves the acute path physiology of critically ill patients and decrease morbidity and mortality during transfer. [40] They contribute to fewer unexpected events than resident physicians.[12][41] Papson's study on the unexpected events during 339 separate intra-hospital transport of 297 critically ill emergency department patients, demonstrated a higher adverse event rate by both junior (221) and senior residents (171) than by emergency physicians (130). [12] Contrary to the above studies by both Bellingan and Papson, Lahner instead found no upsurge in adverse events incidence among junior doctors because both junior and senior doctors responsible for intra-hospital transport had sufficient training on transport and that the equipment used was well-designed for transport purposes.[5]

Environmental factors affecting intra-hospital transport

The environmental factors play a crucial role during the transport process. The transport in uncontrolled environment exposes the critically ill patient to environmental hazards like temperature fluctuation and noise pollution. [32][35] The distances covered, routes and the nature of the pavements used may directly or indirectly have an impact on the patient's safety. The transfer of unstable patients through busy hallways and longer routes exposes them to risks which may

cause suffering and add more physiological stress like anxiety and agitation.[42][43][44] Movement through the corridors, hallways, and elevators put unstable patients at risks of vibration, acceleration, and deceleration, which has a more significant impact on the monitoring especially in traumatic brain injury patients with tight intracranial pressure control. Transport through such an environment can also lead to mal-positioning of the patient, therefore, disconnection of tubings and worsening of their clinical status.[42][43] The corridors and the elevators should be made clearer and booked respectively before departure to pave the way and minimize the delays during the transport process.[16]

Intra-hospital transport Guidelines and protocols

Intra-Hospital transfer involves decision making, planning, and implementation.[21] The patient assessment should be performed, and the decision made by analyzing the benefits of transport vis-a-vis the risks. Unexpected events can be minimized or prevented by the use of a well-designed transport protocol with quick, systematic checklists.[42] A pre-transfer checklist which contains the patient's detailed medical report, a resuscitation kit, medical transfer equipment and the destination of transfer is mandatory.[16] Physiological stabilization of patients should take priority before transfer to minimize further deterioration. [7][21]

Intra-hospital transfer done in an emergency setting without adequate stabilization of the patient and proper checks on transport equipment is associated with the onset of adverse events.[5] Post-resuscitation care measures, particularly in post-cardiac arrest patients should start before the actual transport process began by following the institutional standards of monitoring.[45][46] The institutional guidelines regarding intra-hospital transport should be established and observed to avoid critical incidents.[43] Thorough pre-transfer check on the patient and transport equipment and

dedication to the standard guidelines during the transit facilitate the smooth process and event-free. [27]

There has been an improvement in the conduct of intra-hospital transport since 1999 from the updated recommendations following some clinical studies from intensive care, Emergency Medicine College, and Societies. These recommendations among others include pre-transport coordination and communication, transport equipment, transport staff, monitoring, and documentation. [17][8][35][36] These have led to good practice of intra-hospital transport hence a reduction in the incidence of adverse effects over the span of time since its implementation.[13][19][31][32][47] Beckmann in his study linked the inadequate use of protocols (which contains the equipment and patient checklist) to mismanagement of patients from attentiveness by the transport teams by not observing intra-hospital transport recommended measures. He stresses the need for the adoption of checklists for patient transfer and observance of the protocols to minimize adverse events.[19] The critical care societies namely Australian and New Zealand College of Anesthetists, College of intensive care medicine of Australia and New Zealand and Australasian College for Emergency medicine; has come up with the guidelines on 'The Minimum Standards for Intra-hospital Transport of Critically Ill Patients'.[48] The guidelines are meant to promote measures of safety to critically ill patients during transport.[7][8][21][35][39][49]

Communication during intra-hospital transport and the handover process

Communication during the intra-hospital transfer of patients is of utmost importance as it helps reduce the waiting time and subsequently the transport time.[19][50] It has a significant bearing on the incidence of critical events during transport. The communication errors like miscommunication about the patient's clinical condition and poor documentation of the patient's progress notes in the

healthcare and transport setting are common due to the increasing number of patients' handover amongst caregivers.[51] Beckmann et al. demonstrated that 61% of incidents during the transport is related to inadequate communication regarding monitoring, artificial airway position, and patient positioning.[19] Coordination between the referring and the receiving care teams ensure timely transfer of patients.[27] Any breakdown in communication has an impact on patient safety, as it introduces a gap in the care at every stage of the transfer process [52]. Communication errors have been single out as the primary cause of sentinel events resulting from the patient transfer.[16] Any gap in the communication channels can lead to disruptions in the continuity of care, incorrect treatment, and thus compromise with the management of the patient. [53][54][55]

In a study by Caprice to determine the patterns of communication breakdown from 444 surgical malpractice claims from 4 liability insurers, 60 cases identified had 81 incidences of communication breakdown causing harm to the patients. Verbal communication was highly reported, with 43% of the communication breakdown occurring during handovers and 39% during transfer.[56] Australian based study by Zinn revealed 25,000 to 30,000 avoidable adverse events leading to permanent disability, of which communication issues caused 11% of the adverse events in comparison to 6% caused by insufficient skill levels of physicians.[53]

Handover is vital in the continuation of patient care, and it involves a process of conveying patient-specific information between healthcare teams or from the healthcare personnel to the patient or relatives.[53][57] Correct patient identity and full documentation of medical records and investigation reports should be handed over in an organized manner to avoid loss of information.[27][32] An interruption in smooth handover leads to communication breakdown since every transfer of information poses the risk of data loss. The loss of information may lead to

mismanagement of patients, especially if handing over is performed in a hurry without sufficient time to correctly understand the clinical picture.[16] There is little data to guide initiatives to improve the handover process; however, the use of structured handover and transfer protocols to avert these disruptions is documented.[53]

Kenyatta National Hospital is the largest teaching and referral hospital in East Africa. It has a patient bed capacity of 2000 and there are 4 Critical Care Units. The Critical Care Units receive patients from the wards, operating theatres, accident and emergency department, radiology department and outpatient clinics. There are no written protocols and guidelines in Kenyatta National Hospital regarding intra-hospital transport. This study aims at assessing the different aspects of intra-hospital transport in Kenyatta National Hospital and the challenges associated with it.

3.0 JUSTIFICATION

The intra-hospital transfer is a crucial part of critical care. It has a major bearing on patients outcomes, thus, therefore, has to be performed in a standardized manner. The average monthly CCU transfers in KNH is 100 patients. Operating room, accident and emergency department; and wards are the main catchment areas of these patients. Despite the high number of CCU admissions, there are no standardized written protocols that are used during the transfer of these patients.

The transfer of critically ill patients is done under an emergency setting. This is associated with the increased risk for complications related to change of the patient's physiological status, transport team dynamics, equipment, and monitoring challenges and hospital design and infrastructure challenges. There is a need to establish the magnitude of challenges during IHT in our setting, which has never been done before. The findings from the study will help establish a practice gap during IHT of critically ill patients. Inferences from this study will increase the body of knowledge on IHT and may form the basis for developing intra-hospital transport protocols and further research.

3.1 Research question

What are the challenges encountered during the intra-hospital transfer of critically ill patients to Kenyatta National Hospital critical care units?

3.2 Objectives

3.2.1 Broad objective

To establish the challenges during the intra-hospital transfer of critically ill patients to Kenyatta National Hospital critical care units.

3.2.2 Specific objectives

1. To establish the equipment related challenges during the intra-hospital transfer of critically ill patients to Kenyatta National Hospital critical care units.
2. To establish the transport team-related challenges during the intra-hospital transfer of critically ill patients to Kenyatta National Hospital critical care units.
3. To establish the infrastructure-related challenges during the intra-hospital transfer of critically ill patients to Kenyatta National Hospital critical care units.

4.0 MATERIALS AND METHODS

4.1 Study design

A Cross-sectional study of the intra-hospital transport of critically ill patients into Kenyatta National Hospital critical care units.

4.2 Study Area

Kenyatta National Hospital is the largest referral and teaching hospital in East Africa with a countrywide catchment area. It has 50 wards, 22 outpatient clinics, 24 theatres (16 specialized) and Accident & Emergency Department with the total bed capacity of 2000. It also has a main CCU with 21-bed capacity situated close to the main theatre and 4 auxiliary intensive care units with a total of 27 beds situated in the accident and emergency department, pediatric, surgical and medical wards. There are 12 major operating theatres, 2 maternity theatres, 2 trauma theatres and 8 other satellite theatres whose functioning is augmented by the main CCU and its auxiliary intensive care units. Both the main CCU and its auxiliary intensive care units have a monthly average admission of 100 patients with heavy trauma, neurosurgical and medical caseload.

4.3 Site of study

Kenyatta National Hospital Critical Care units.

4.4 Study population

Critically ill patients and the service providers act as a unit. The service providers provided information regarding the patient and the transport process. The study population was all service providers involved in the transfer of critically ill patients who are already admitted to KNH and requires admission into the KNH CCUs.

4.5 Eligibility criteria

4.5.1 Inclusion criteria

All transport team leaders involved in the transfer of critically ill patients to KNH CCUs who consented to the study were recruited.

4.5.2 Exclusion criteria:

1. All transport team leaders involved in the transfer of critically ill patients to KNH CCUs who decline to give consent to participate in the study.
2. All transport team leaders involved in the transfer of critically ill patients from one critical care unit to another critical care unit within the hospital.

4.6 Sample size determination

The sample size was calculated using Fisher's formula.[58]

$$n = \frac{Z^2 x\, P(1-P)}{d^2}$$

Where,

n = Desired sample size

Z = value from standard normal distribution corresponding to the desired confidence level (Z=1.96 for 95% CI)

P = expected true proportion (estimated at 67.9%, from a prospective observational study conducted by Jonathan P.N. et al. (2007) over a period of 16 months i.e. March 2003 to June 2004 in major trauma and quaternary referral center, found 67.9% of them were associated with unexpected events.)

d = desired precision (0.05)

$$n_0 = \frac{1.96^2 x\, 0.679(1-0.679)}{0.05^2} = 335$$

A sample size of 335 transport team leaders involved in the transfer of the critically ill patients to KNH ICUs was used for the study.

4.6.1 Sampling technique

Consecutive sampling of the service providers (transport team leaders) doing the transfer of critically ill patients who are already admitted to KNH and requires admission into the KNH CCUs.

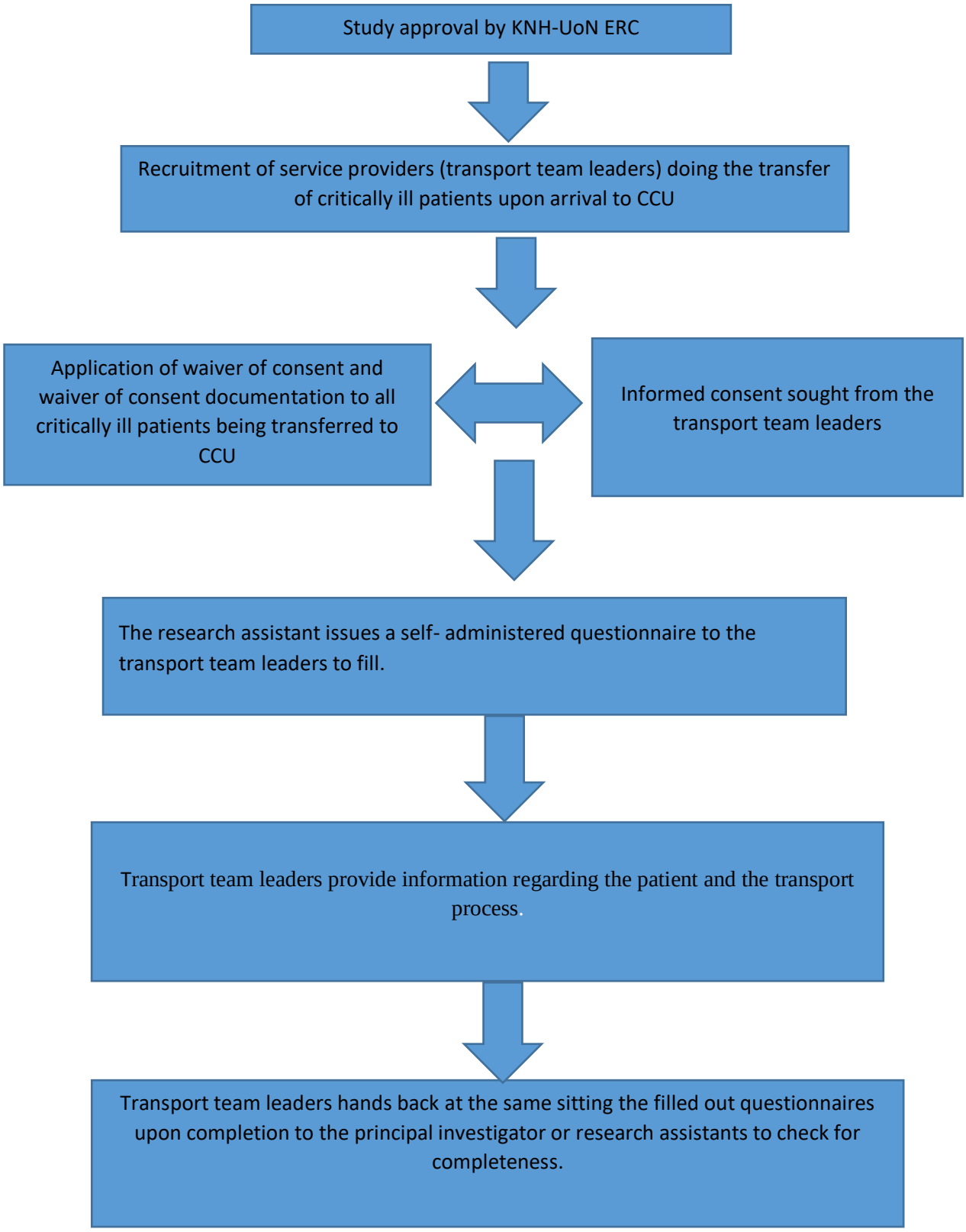
4.7 Recruitment and consenting procedures

The study was undertaken in the KNH critical care units after the approval of Kenyatta National Hospital/University of Nairobi-Ethics and Research committee. All the service providers (transport team leaders) doing the transfer of the critically ill patients who are already admitted to KNH and requires transfer into any of the 4 critical care units was recruited consecutively upon arrival in the critical care unit.

Informed consent was sought from the transport team leader **(APPENDIX 2).** Application for **waiver of consent and waiver of consent documentation** (**APPENDIX 3)** was also sought from the KNH/UON ERC and this was used in all critically ill patients who require transfer to the critical care units.

Upon arrival in the critical care unit, the principal investigator or the research assistant immediately issued a self-administered questionnaire to the transport team leader who consented to fill. The transport team leader then provided information regarding the patient and the transport process. The questionnaire was serialized and contained information regarding patient demographic details and reason for the transfer, transport team details, equipment and monitoring used and challenges encountered during transport (**APPENDIX 4**). Upon completion, the filled out questionnaires was handed back at the same sitting to the principal investigator or research assistants to check for completeness.

4.8 Conceptual framework



4.9 Data Management and Analysis Plan

Data collected via the questionnaire was entered and analyzed by the use of SPSS version 21. The specific objectives, i.e. to establish the equipment, transport, and infrastructure-related challenges were analyzed and presented by the use of frequencies and proportions. Where applicable for certain continuous variables such as the age of the patient, and time was analyzed by use of means and standard deviations or medians with interquartile range. Where appropriate, charts and other graphs were used to display the distribution of certain characteristics.

5.10 Ethical consideration

1. Permission was sought from Kenyatta National Hospital-University of Nairobi, Ethics and Research Committee before undertaking the study
2. The nature and purpose of the study was explained to the service providers (transport team leaders)
3. The study had no harmful effects on the patients and the service providers.
4. Confidentiality was maintained at all times
5. There were no additional cost implications to the patient and the service providers.
6. Findings from the study will be availed to the Ethics Committee of KNH and the University of Nairobi.

5.0 RESULTS

5.1 Preliminary information

Transport team leaders transporting 335 critically ill patients from the wards, theatres, accident, and emergency department to the 4 critical care units within KNH were enrolled into the study between June 2018 and September 2018. The transport team leaders were interviewed regarding the transport process. Table 1 below shows the gender and the age distribution of patients being transported during the study period.

Table 1: Gender and age distribution

	Frequency n (%)
Gender	
Male	183 (54.6)
Female	152 (45.4)
Age (years)	
<1.0	22 (6.6)
1 – 10	63 (18.8)
11 – 20	30 (9.0)
21 – 30	55 (16.4)
31 – 40	56 (16.7)
41 – 50	39 (11.6)
51 – 60	35 (10.4)
61+	35 (10.4)

There were 183 (54.6%) male patients transferred giving female to male ratio of 1:1.2. The mean age of the patients evaluated during the intra-hospital transfer study was 31.1 years with ages ranging from 1 month to 90 years. The predominant group of patients was the pediatric age group of 1-10 who accounted for 18.8% of the total transfers followed by the two peaks of young adults at the age groups of 31-40 and 21-30 representing 16.7% and 16.4% respectively. The infants accounted for 6.6% while the older patients above 60 years represented 10.4% of the total transfers.

5.2 Site of Origin

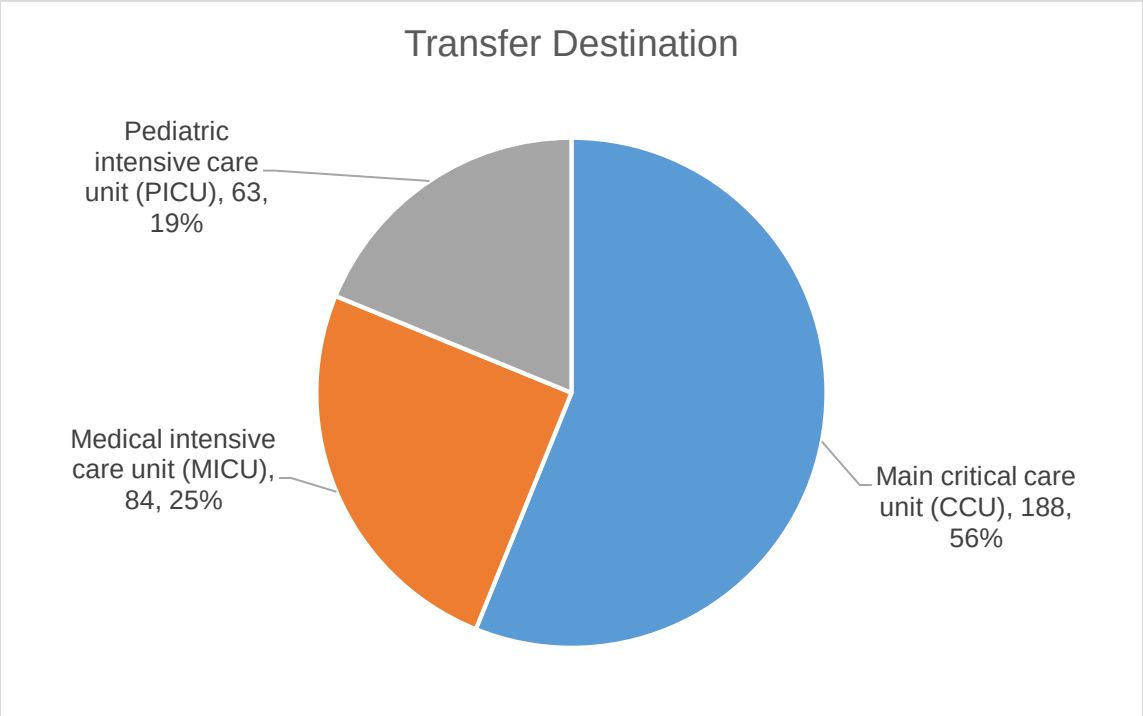
Table 2: Site of origin

	Frequency	**%**
Accident and Emergency department	**91**	**27.2**
Wards	**117**	**34.9**
Surgical	24	20.5
Medical	93	79.5
Theatre	**125**	**37.3**
Planned admissions	76	60.8
Unplanned admissions	49	39.2
Others	**2**	**0.6**

The majority of the transfer originated from the operating theatres representing 125 (37.3%), followed by the wards at 117 (34.9%). There were two transfers indicated as others, one from the renal and the other from the endoscopy unit accounting for 0.6% of the total transfer. Most of the theatre admissions to the CCUs were planned 76 (60.8%) while the majority of the wards admissions were from the medical wards 93 (79.5%).

5.3 Transfer Destination

Figure 1: Transfer destination



The main CCU had the highest number of transfer at 188 (56%). This was due to its high bed capacity compared to the medical intensive care unit (MICU) 84 (25%) and Pediatric intensive care unit (PICU) 63 (19%).

5.4 Indications for Transfer

Table 3: Indication for ICU admission from the wards and accident and emergency department based on the number of organ systems affected

	Number of organ system failure (%)				**TOTAL**
	One	**Two**	**Three**	**Four**	
	CVS=14	RS+CNS=52	RS+CNS+MD=10	RS+CVS+CNS+MD=4	
	RS=36	RS+CVS=16	CVS+CNS+MD=1		
	CNS=12	RS+MD=12	RS+CVS+CNS=6		
	MD=10	CVS+CNS=9	RS+CVS+MD=13		
		CNS+MD=6			
		CVS+MD=9			
Subtotal	**72 (34.3%)**	**104 (49.5%)**	**30 (14.3%)**	**4 (1.9%)**	**210**

NB: RS: Respiratory Support; **CNS:** Central Nervous System; **MD:** Metabolic Derangement; **CVS:** Cardiovascular Support

Table 3 shows that the majority of the critically ill patients presented with altered physiological status and had at least one life-threatening organ failure. A total of 72 (34.3%) admissions had single organ system failure while 104 (49.5%) had two organ systems failure. Respiratory system (36) was the most commonly affected system amongst patients with single organ-system failure. Respiratory system and central nervous system were generally the most common organ systems affected.

Table 4: Indications for planned admissions from theatres based on number of organ systems affected

	Number of organ system affected (%)			**Total**
	One	**Two**	**Three**	
	CNS=25	RS+MD=3	RS+CVS+CNS=3	
	CVS=14	RS+CNS=11		
	RS=10			
	EL=10			
Subtotal	**59 (77.6%)**	**14 (18.4%)**	**3 (3.9%)**	**76**

NB: RS: Respiratory support; **CNS:** Central nervous system; **MD:** Metabolic derangement; **CVS:** Cardiovascular support; **EL:** Elective Postop Monitoring

A total of 59 (77.6%) planned admissions had one organ system affected while 3 (3.9%) had three organ systems failure. Majority of the patients with one organ system affected had a central nervous system failure (25). There were also 10 patients admitted for elective postoperative monitoring.

Table 5: Indications for unplanned admissions from theatres based on number of organ systems affected

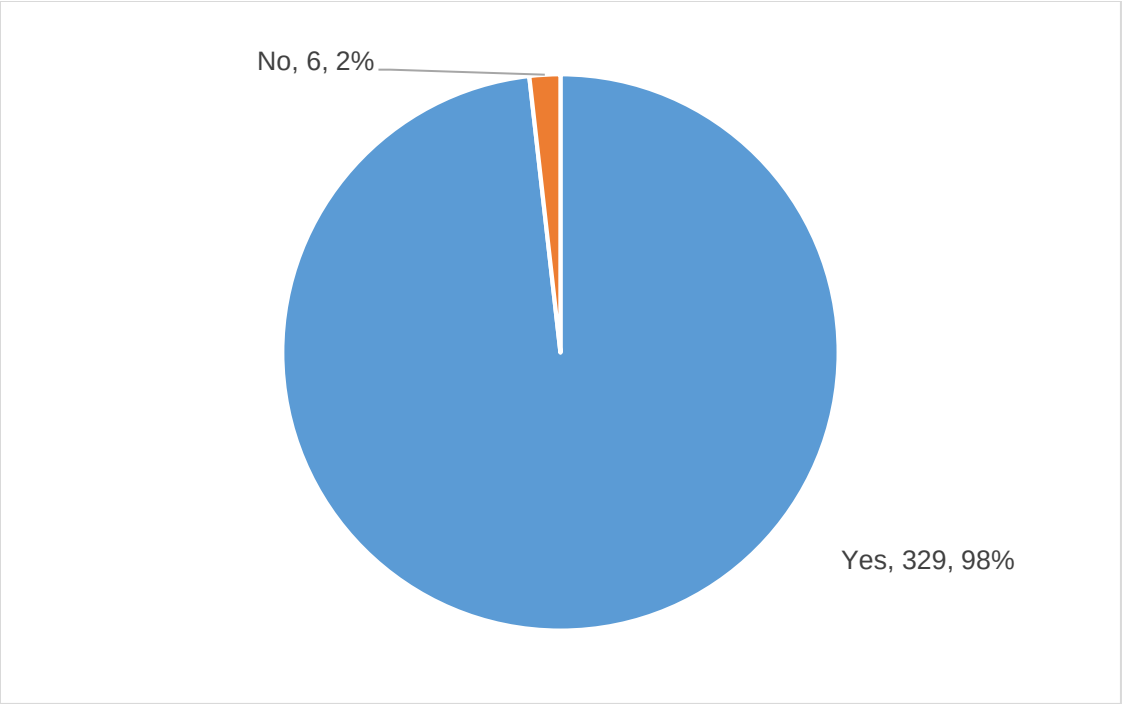
	Number of organs affected (%)				TOTAL
	One	**Two**	**Three**	**Four**	
	CNS=8	CVS+CNS=5	RS+CNS+MD=1	RS+CVS+CNS+MD=3	
	RS=5	RS+CNS=9	RS+CVS+MD=1	RS+CVS+CNS+MD=1	
	CVS=2	CNS+MD=1	RS+CVS+CNS=6		
		RS+CVS=1	CVS+CNS+MD=2		
		CVS+MD=2			
		RS+MD=2			
Subtotal	**15 (30.6%)**	**20 (40.8%)**	**10 (20.4%)**	**4 (8.2%)**	**49**

RS: Respiratory support; **CNS:** Central nervous systems; **MD:** Metabolic derangement; **CVS:** Cardiovascular support;

Most of the unplanned theatre admissions had at least more than one organ system affected by the central nervous system and the respiratory system. Only 15 (30.6%) planned admissions had one organ system affected.

5.5 Communication to the receiving unit

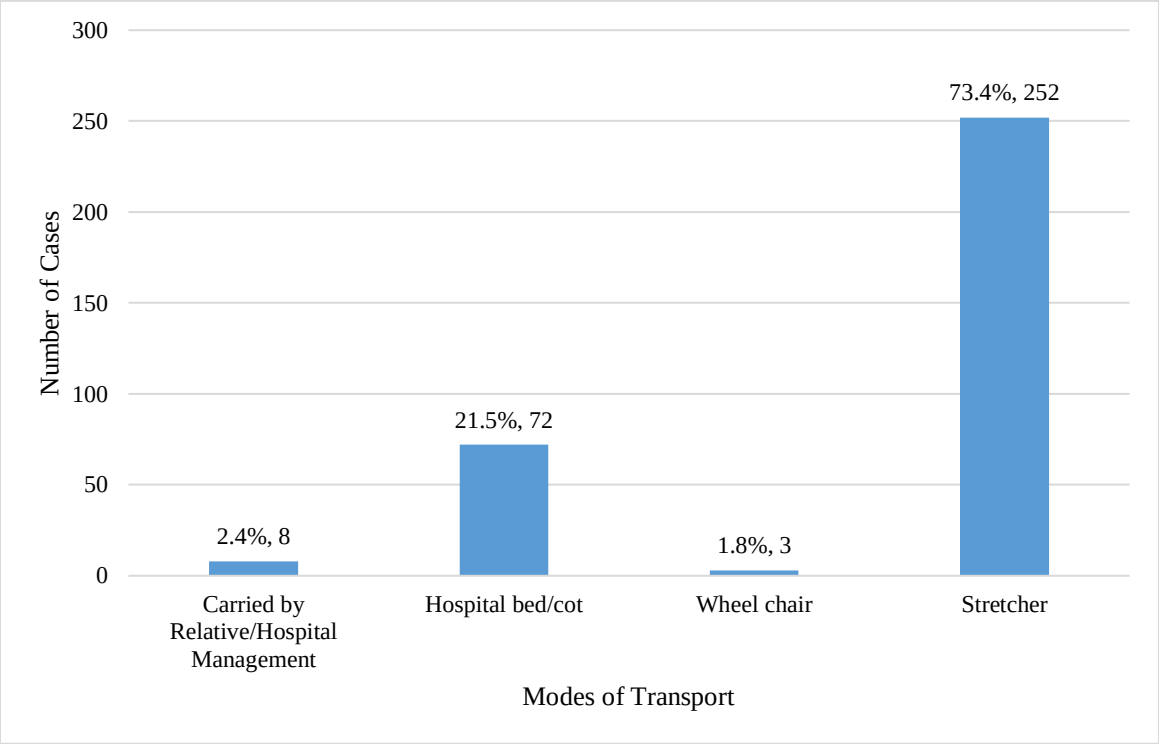
Figure 2: Communication to the receiving unit



A total of 329 (98%) transports was planned i.e. they only happened following adequate communication with the respective receiving units.

5.6 Mode of Transport

Figure 3: Mode of transport



The most common mode of transport of the critically ill patients was via the stretcher 252 (73.4%). Some of the pediatric patients especially the infants were carried by their relatives (mothers) 8 (2.4%).

5.7 Transport Teams

Table 6: Composition of the transport teams

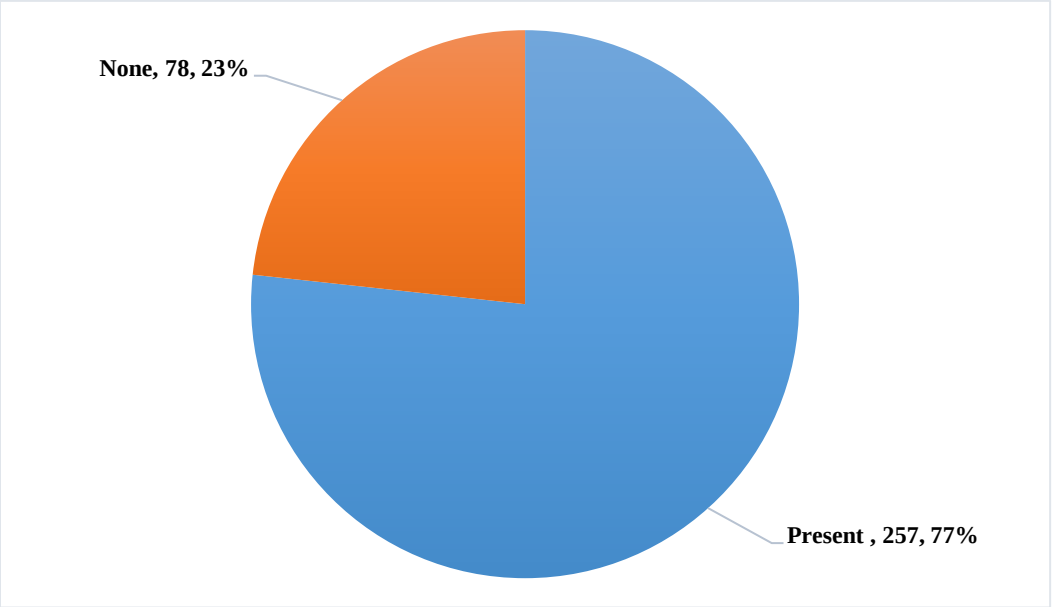
	Number of personnel (%)					TOTAL
	One	**Two**	**Three**	**Four**	**Five**	
	N-26	N+NP=2	N+P+NP=21	N+P+R+Port=23	N+P+NP+R+Port=1	
	P-1	N+Port=30	N+P+Port=55	N+P+NP+R=4		
		N+P=42	N+P+R=20	N+NP+R+Port=3		
		N+R=28	N+NP+Port=9	N+P+NP+Port=22		
		P+Port=1	N+NP+R=5			
		P+NP=4	N+R+Port=37			
		N+Phys=1				
Subtotal	**27 (8.1%)**	**108 (32.2%)**	**147 (43.9%)**	**52 (15.5%)**	**1 (0.3%)**	**335**

NB: N-Nurse, **P**-Physician, **NP**=Non-physician, **R**-Relative, **Port**-Porter, **Phys**-Physiotherapist

The transport teams were composed of the nursing staff, physician/ non-physicians, porter and relatives. Most of the transfers were carried out by more than one caregivers with or without the accompaniment of the patients' relatives. Majority of the transports, 147 (43.9%) were transferred by the transport team consisting of three caregivers with the nurse and physician/non-physician forming part of the team. 27 (8.1%) of the transports had only one person doing the transfer, the nurses (26) being the majority. Most of the transfer cases had a nurse forming part of the transport team except in two cases.

5.8 Monitoring Modalities during Transport

Figure 4: Monitoring Modalities during Transport



A total of 78 (23.3%) transports were visually observed by the transport team but their vital signs not documented, while the rest of the transports were monitored using different modalities and their vital signs documented.

Table 7: The number of monitoring modalities during transport

	Number of monitoring Modalities (%)					TOTA
	None	**One**	**Two**	**Three**	**Four**	
		RR=80	RR+HR=4	RR+HR+SPO2=74	RR+HR+BP+SPO2=37	
			HR+SPO2=30	RR+HR+BP=12	RR+HR+BP+Temp=2	
			RR+BP=9	HR+BP+SPO2=6	RR+HR+SPO2+Temp=3	
Subtotal	**78 (23.3%)**	**80 (23.9%)**	**43 (12.8%)**	**92 (27.5%)**	**42 (12.5%)**	**335**

NB: RR-Respiratory rate, **HR**-Heart rate, **BP**-Blood pressure, **SPO2**-Oxygen saturation, **Temp**-Temperature

Monitoring included the use of clinical observation of the respiratory rate & vital signs monitors such as pulse oximeter, blood pressure machine and thermometer, and ECG monitor. A total of 78 (23.3%) transports were visually observed by the transport teams but their vital signs not documented, while the rest of the transports were monitored using different modalities and their vital signs documented. Respiratory rate (breathing) and heart rate were monitored in most of the transports compared to other modalities. Only 92 (27.5%) transports had at least 3 monitoring modalities and it consisted among them a respiratory rate, heart rate, blood pressure, and SPO2. Out of the total transports, 80 (23.9%) of them had one modality being monitored i.e respiratory rate.

5.9 Resuscitation equipment during transport

Table 8: Resuscitation equipment during transport

	Number of resuscitation equipment (%)				**TOTAL**
	None	**One**	**Two**	**Three**	
		S=73	B+S=70	B+L+S=8	
		B=35	B+O=2	B+L+O=2	
		O=7	S+O=13	B+S+O=35	
Subtotal	**90 (26.9%)**	**115 (34.3%)**	**85 (25.3%)**	**45 (13.4%)**	**335**

NB: S-Stethoscope, **B**-Bag-Valve Mask, **L**-Laryngoscope + Endotracheal tube, **O-** Oropharyngeal airway

The resuscitation equipment present consisted of the stethoscopes, bag valve masks, oropharyngeal airways, laryngoscopes, and endotracheal tubes. A total of 90 (26.9%) transports had no resuscitation equipment while 45 (13.4%) of them had three. Majority 115 (34.3%) had only one transport equipment with stethoscope and bag valve mask being the most common. Laryngoscopes and endotracheal tubes were the least common resuscitation equipment.

5.10 Resuscitation drugs during transport

Table 9: The number of resuscitation drugs

	Number of resuscitation drugs (%)				TOTAL
	None	**One**	**Two**	**Three**	
		Ad=27	Ad+At=17	Ad + At + D =2	
		At =7	Ad + B =2	Ad + At + Ca =3	
		B =5	Ad + D =1		
		D =5			
		Ca =4			
Subtotal	**262 (78.2%)**	**48 (14.3%)**	**20 (6.0%)**	**5 (1.4%)**	**335**

NB: Ad-Adrenaline, **At**-Atropine, **B**-Sodium bicarbonate, **D**-Dextrose, **Ca-**Calcium gluconate

The resuscitation drugs available during transport included adrenaline, atropine, sodium bicarbonate, dextrose, and calcium gluconate. Majority of the transports 262 (78.2%) had no resuscitation drugs. Many transfers had only one resuscitation drug 48 (14.3%). Adrenaline was the most common resuscitation drug.

Table 5.10. Intubated and non- intubated patients

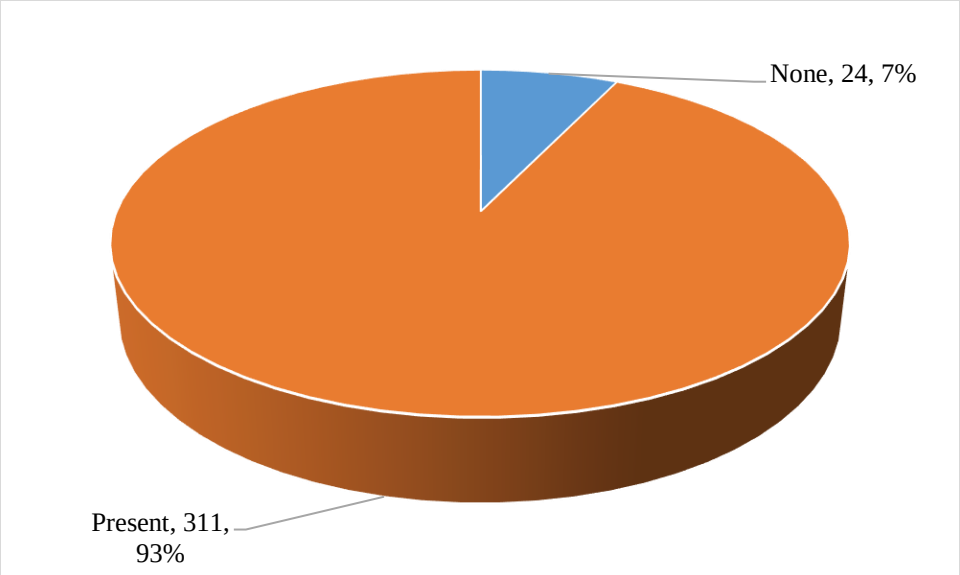
Table 10: Intubated and non- intubated patients

	Frequency	**%**
Intubated	**122**	**36.4**
Manual ventilation	109	89.3
Spontaneous	13	10.7
Not Intubated	**213**	**63.6**
Face Mask	139	65.3
Nasal Prongs	36	16.9
Bag mask ventilation	2	0.9
Room Air	36	16.9

Majority of the transported patients 213 (63.6%) were not intubated. They were on supplemental oxygen by either face mask, nasal prongs, ventilation mask or breathing spontaneously on room air. A total of 139 (65.3%) non-intubated patients were on supplemental oxygen via face mask while 36 (16.9%) were breathing spontaneously on room air. Out of 122 (36%) intubated patients, 109 (89%) were manually ventilated with ‘self-inflating bag' (Ambu bag) and none was on the portable transport ventilator. Only 13 (11%) of them were breathing spontaneously.

5.11 Intravenous Access

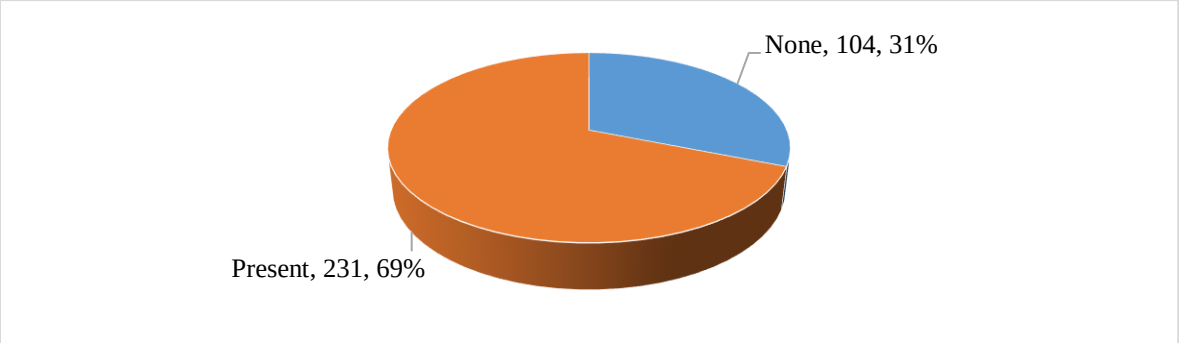
Figure 5: Intravenous access



A total of 311 (93%) transported patients had peripheral intravenous access.

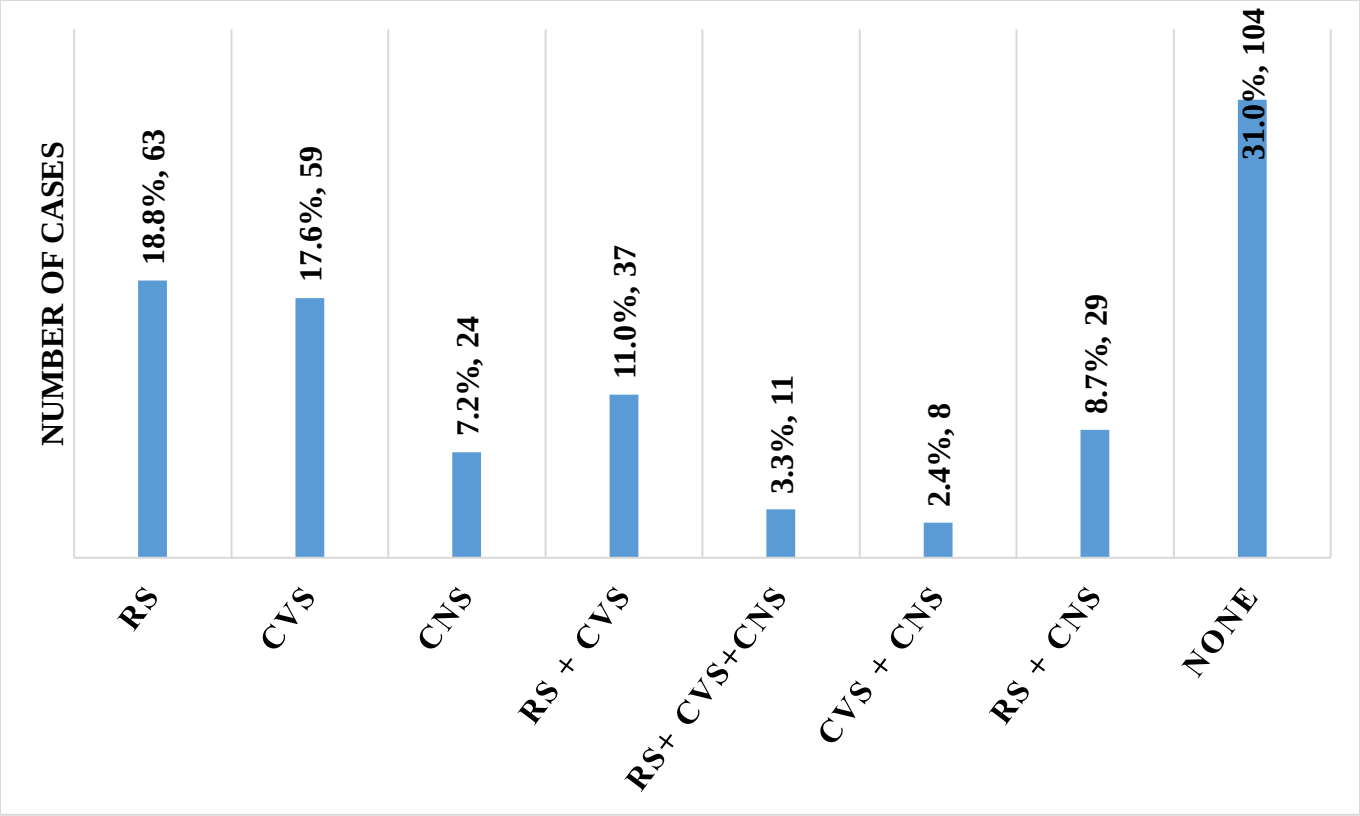
5.12 Patient systemic events during transport

Figure 6: Patient systemic events during transport



A total of 231 (69%) transports had systemic events involving the cardiovascular, respiratory and the central nervous system.

Figure 7: Systems affected during transport

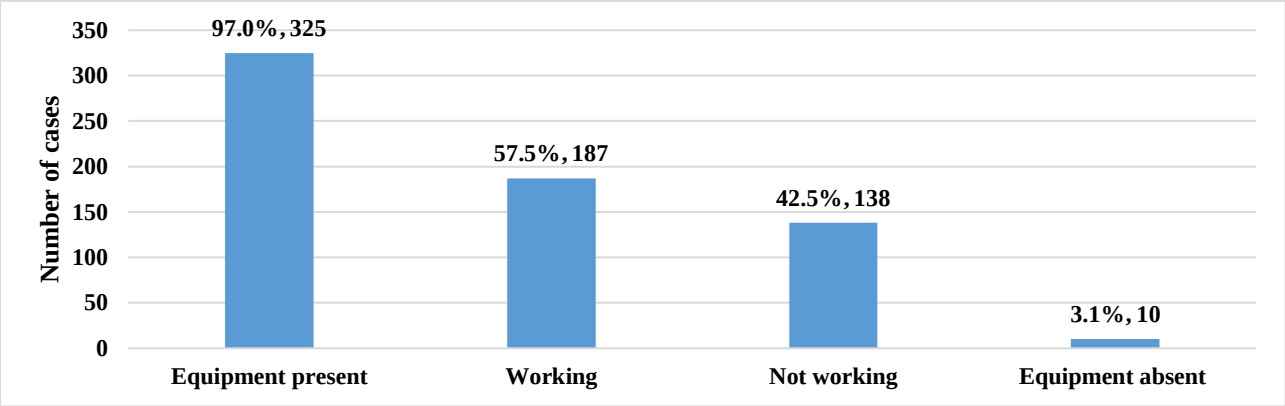


NB: RS: Respiratory support; **CNS:** Central nervous systems; **CVS:** Cardiovascular support

The cardiovascular and respiratory systems were the most affected systems. Most transports had more than one systems affected. The most common patient systemic events during transport was in the respiratory system 63 (18.8%) followed by the cardiovascular system 59 (17.6%). A total of 11 (3.3%) transports had three systems affected i.e the cardiovascular, central nervous system and the respiratory system involved.

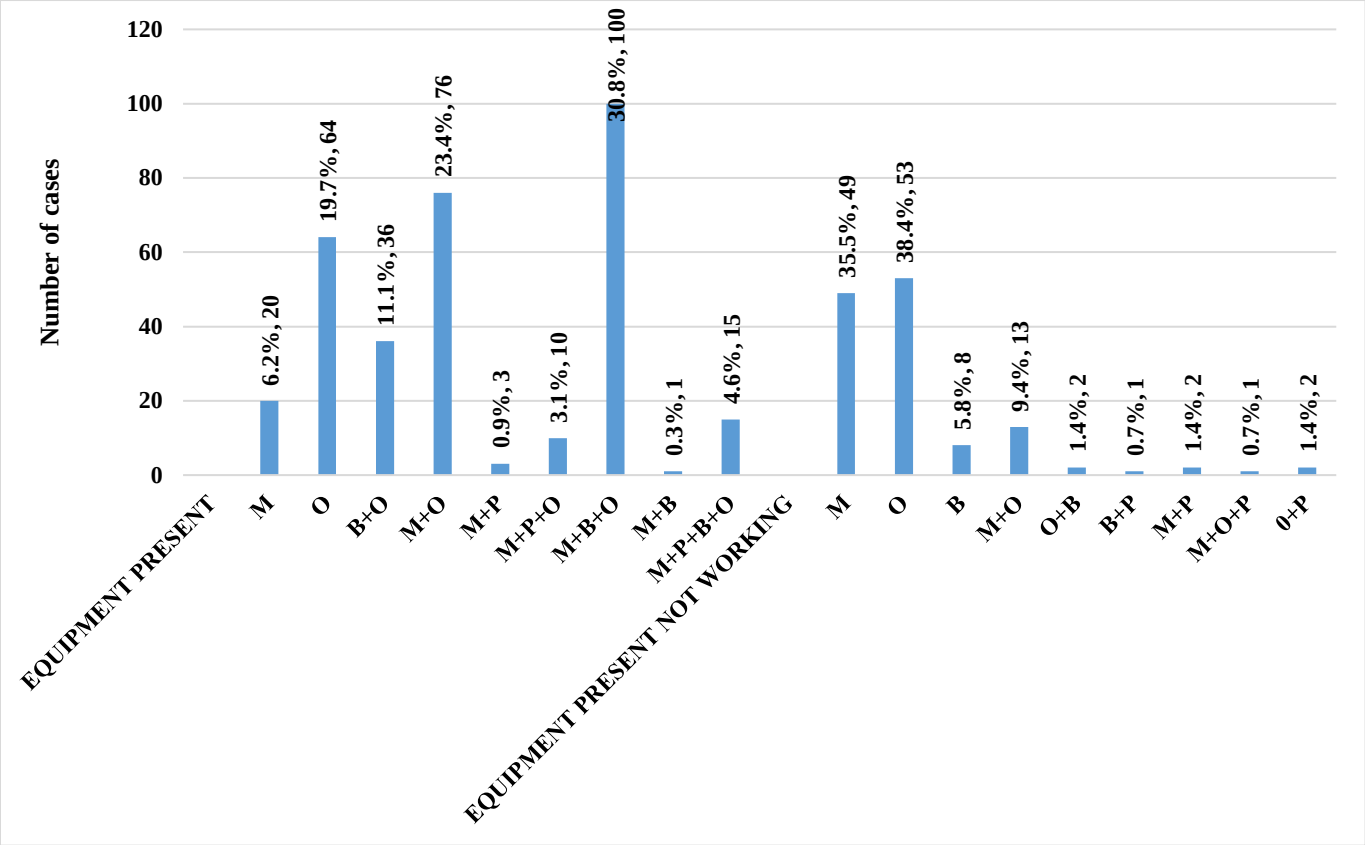
5.13 Equipment Related Events

Figure 8: Equipment during transport



The equipment considered were those for monitoring (pulse oximeter, blood pressure machine, thermometer and ECG monitor), oxygen cylinders, bag valve mask, and infusion pumps. Out of the total transports, 325 (97%) of transfers had equipment present from their source of origin to their destination with 138 (42.5%) of them having equipment that were not working. Only 10 (3.1%) transports had equipment absent.

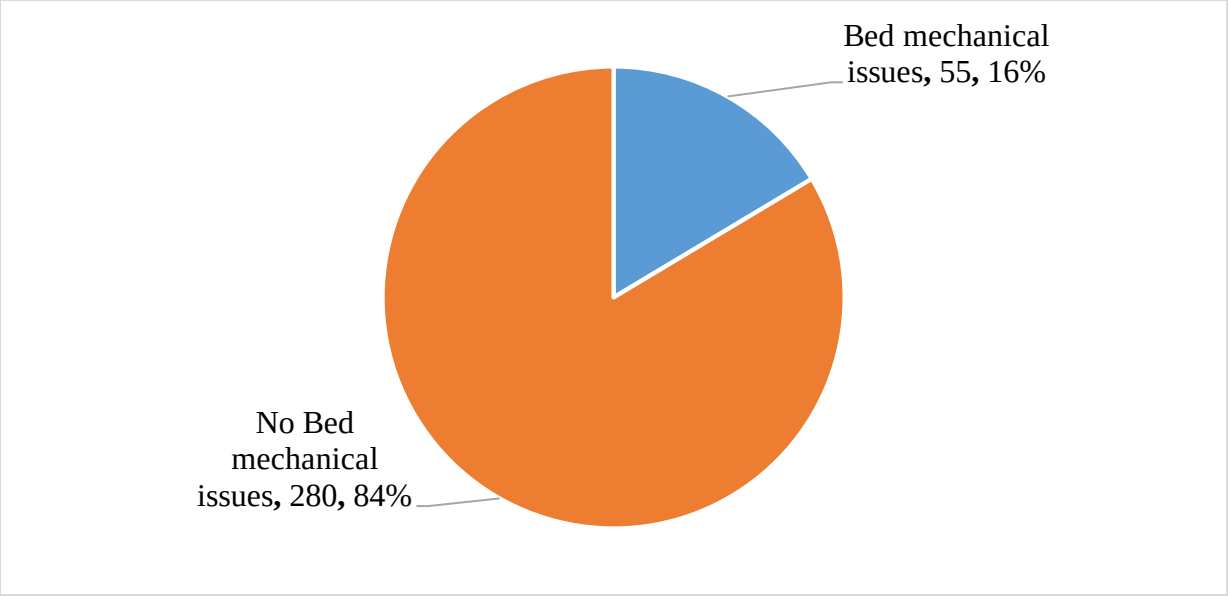
Figure 9: Cases transported with equipment



NB: M: Monitoring**; O:** Oxygen cylinders; **B:** Bag Valve Mask; **P:** Infusion Pumps

Most of the transports had more than one equipment present with only a few having one, that is monitoring equipment 20 (6.2%) and oxygen cylinders 64 (19.4%). Majority of the transports 100 (30.8%) had 3 equipment present i.e monitoring equipment, oxygen cylinder and bag valve mask. Only 15 (4.6%) transports had 4 equipment present namely monitoring equipment, infusion pumps, bag valve mask, and oxygen cylinder. A total of 138 (42.5%) transports with equipment present had equipment failures which were due to either its malfunction or technical hitches. The monitoring equipment and the oxygen cylinders failures in isolation were reported in 49 (35.5%) and 53 (38.4%) transports respectively. Only one transport (0.7%) reported the failure of 3 equipment present i.e. monitoring equipment, oxygen cylinder, and infusion pump.

Figure 10: Bed related events:



A total of 55 (16%) transports had bed mechanical issues related to the wheels and castors, side rail latches, braking mechanisms, check valves and headsprings.

5.14 Infrastructure

Table 11: Infrastructure

	Frequency n (%)	
	Yes	**No**
Elevator working	315 (94.0)	20 (6.0)
Clear pathways/corridors	206 (61.5)	129 (38.5)

The elevators were not working in 20 (6%) transports, while the path through which transport occurred i.e corridors and hallways was not clear during the transfer of 129 (38.5%) cases.

5.15 Handover

Table 12: Handover

	Frequency n (%)	
	Yes	**No**
Patient identity correct	335 (100.0)	
Patient transfer notes documented	335 (100.0)	
Documented by:	**% of Cases**	
Transport Nurse	301 (89.9)	34 (10.1)
Transport Physician/Non-physician	160 (47.8)	175 (52.2)

All critically ill patients transported to the critical care units had the correct identity during handing over process and their transfer notes were well documented by either the transport nurse or physician/ non-physician or both. The transfer notes were documented by the transport nurse and physician/ non-physician in 301 (89.9%) and in 160 (47.8%) of the transports respectively.

6.0 DISCUSSION

A total of 335 critically ill patients were transferred from the wards, theatres, accident and emergency department to the four critical care units within KNH over a period of 14 weeks. 335 transport team leaders doing the transports were enrolled into the study consecutively using the inclusion criteria upon arrival in the critical care units and interviewed regarding the transport process. The mean age of patients was 31.1 years with ages ranging from 1 month to 90 years. There were 183 (54.6%) male patients transferred giving female to male ratio of 1:1.2. The predominant group of patients was the pediatric age group of 1-10 who accounted for 18.8% of the total transports followed by two peaks of young adults at the age groups of 31-40 and 21-30 representing 16.7% and 16.4% respectively. The infants accounted for 6.6% while the older patients above 60 years represented 10.4% of the total transports.

The majority of the transports to the CCUs came from the operating theatres representing 125 (37.3%), followed by the wards at 117 (34.9). 76 (60.8%) of the transports from the operating theatres to the CCUs were planned admissions. The main CCU had the highest number of admissions and it represented 188 (56%) of the total admissions due to its high bed capacity compared to the medical intensive care unit (MICU) and pediatric intensive care unit (PICU) which received 84 (25%) and 63 (19%) of the total admissions respectively.

The admissions from the wards, renal unit, endoscopy unit, and accident and emergency department was 210 (62.7%). Majority of these patients presented with altered physiological status and had at least one life-threatening organ failure. Respiratory system and central nervous system were the most common organ systems affected. The indications for planned admissions 76 (60.8%) from the operating theatres were based on the organ systems affected and the need for postoperative monitoring. Most of these admissions had one organ system affected representing

59 (77.6%) of the total planned admissions while only 3 (3.9%) of them had three organ systems failure. These patients came from the neurosurgical, trauma and cardiac operating theatres. Most of the unplanned theatre admissions to the CCUs had more than one organ system affected with CNS being the most affected organ. Majority of them came from the trauma theatre, the maternity theatre, and a few from the main theatre. The CCU admission criteria in KNH is based on the diagnostic model which focuses on the organ system affected and the specific conditions or diseases to determine the appropriateness of CCU admission. Some of the factors considered to make triage decisions are the number of CCU beds available, admitting diagnosis, age, the severity of illness, baseline functional status, prognosis, and operative status of the critically ill patients.[59][60] The triage decisions vary in the institutions based on the CCU resource allocations and the bulky workloads of the critically ill patients within the facilities. According to the guidelines from the Society of Critical Care Medicine (SCCM), the admission of the critically ill patients to the CCUs using Prioritization model should be selected based on their projected likelihood of benefit from those who will benefit most from the ICU (Priority 1) to those that will not benefit at all (Priority 4) from ICU admission. [60]

A total of 329 (98 %) transports happened following adequate communication with the respective receiving units. The patient's clinical condition, the intention to transfer and the CCU strain (bed availability) were confirmed pretransfer. The pre-existing guidelines support that, there should be good communication between the referring and the receiving clinicians in order to speed up the commencement of care and ensures smooth continuity of care.[61] Studies have shown that the communication between critical care units and sites of destination or origin is vital for reducing waiting time and therefore transport time. [13][62]

The most common mode of transport of the critically ill patients was via the stretcher representing 252 (73.4%). Some of the pediatric patients especially the infants were carried by their relatives (mothers) 8 (2.4%). The guidelines for the transport of critically ill patients recommend that the mode of transport chosen should depend on the nature of the disease, the clinical impact of the transport environment, the urgency of intervention, the location of the patient, distances involved, medical and transport team experience. [39]

The transport teams were composed of the nursing staff, physician/ non-physicians, porter and relatives. There was no dedicated transport team for IHT at the KNH. Most of the transfers were carried out by more than one person with or without the accompaniment of the patients' relatives. Majority of the transports, 147 (43.9%) were transferred by teams consisting of three personnel with the nurse and physician/non-physician forming part of the team. According to the College of Intensive Care Medicine, the transport team plays a crucial role in patients transfer and should consist of at least a qualified trained nurse and a medical practitioner. [35]

Monitoring was done by the use of clinical observation and use of vital signs monitors. Vital signs monitors included a pulse oximeter, blood pressure machine, thermometer, and electrocardiogram monitor. A total of 78 (23.3%) transports did not have a vital signs monitor but were clinically monitored. Respiratory rate (breathing) and heart rate were monitored in most of the transports compared to other modalities. Only 92 (27.5%) transports had at least 3 monitoring modalities which included respiratory rate, heart rate, blood pressure, and oxygen saturation. A total of 80 (23.9%) transports had one modality being monitored: respiratory rate. According to the guidelines on IHT, the minimum standards for monitoring during intra-hospital transport of critically ill-patients include continuous oxygen saturation, electrocardiogram, non-invasive blood pressure, respiratory rate, and heart rate. Other supplementary monitoring modalities like capnography and

invasive monitoring for arterial blood pressure, central venous pressure, pulmonary artery pressure, and intracranial pressure can be done depending on the patient's clinical status.[8][26][27]

A dedicated emergency trolley was absent during the transfer of all the critically ill patients, however, the caregivers carried with them basic resuscitation drugs and equipment including; intubation equipment, definitive airway equipment, stethoscope, and adjuncts. The resuscitation equipment present consisted of a stethoscope, bag valve mask, oropharyngeal airway, laryngoscope, and endotracheal tube. A total of 90 (26.9%) transports had no resuscitation equipment. The stethoscopes and bag valve masks were the most common resuscitation equipment present. The resuscitation drugs available were adrenaline, atropine, sodium bicarbonate, dextrose, and calcium gluconate. 262 (78.2%) of the transports had no resuscitation drugs and 48 (14.3%) had one resuscitation drug. The minimum standards for intrahospital transport of critically ill patients recommends that a defibrillator and a functional suctioning device, a manual resuscitator bag, equipment to secure the airway, emergency drugs, analgesics, sedatives, and muscle relaxants must be made available during transport. Other additional drugs, intravenous fluids, inotropic solutions, or blood should be made available if needed.[63][64]

213 (63.6%) of the transported patients were not intubated. They were on supplemental oxygen by either face masks, nasal prongs, ventilation mask or breathing spontaneously on room air. A total of 122 (36%) transported patients were intubated with a majority of 109 (89%) being manually ventilated with ‘self-inflating bag' (Ambu bag). None of the intubated patients was on a portable ventilator due to its unavailability within the hospital. The guidelines recommend the use of a functional portable ventilator in intubated patients with different modes of ventilation.[63][64]

The equipment present during IHT were those for monitoring, oxygen cylinders, bag valve masks, and the infusion pumps. Equipment failure was recorded in 138 (42.5%) transports. This was consistent with the outcomes from the critical care reviews which reported equipment adverse events in up to 71% of the transports.[17] Most transports had more than one equipment failure. Monitoring equipment malfunction was reported in 49 (35.5%) of the patients transported. The malfunction in this equipment occurred due to disconnection from patient and power supply failure. According to Whiteley et.al, the displays of all monitors should be made accessible and visible to the escorting staff to ensure that there is constant monitoring.[65] Continuous monitoring throughout the transport process is essential and has been shown to prevent adverse changes and a further reduction in the physiological reserves.[62][65] Airway equipment malfunction reported included short oxygen tubes, faulty check valve unit, inappropriate bag and mask size for age and the leakage of the self-inflation silicone bag. Oxygen cylinders malfunction was present in 53 (38.4%) of the patients transported. Malfunction of the cylinders was due to failure of oxygen control knobs and breakage/leakage of the flowmeters. The college of intensive care medicine recommends that before initiating any transport, the oxygen cylinders must be full with a spare oxygen cylinder available. The oxygen flowmeters should be serviced regularly and malfunctioned flowmeters replaced.[63][64]

Hospital beds were the most common mode of transport in all the critically ill patients except in the three transfers where the patients were on wheelchairs. Only 55 (16%) transports had bed mechanical issues related to the wheels and castors, side rail latches, braking mechanisms, check valves and headsprings. The absence of the side rail latches was more risky and harmful to the patients who were agitated and restless, however, there were no falls from beds reported. Malfunction of the wheels and castors made movement difficult especially from the accident and

emergency department to the intensive care units due to the long distances covered. Most beds had no headsprings which made it difficult to position patients properly especially those who needed the head of the bed up due to their medical conditions especially the cardiac and the neurosurgical patients.

Infrastructure plays a crucial role in the transport process. Transport of the critically ill patient exposes them to environmental hazards like temperature fluctuation and noise pollution.[35][32] Only 20 (6%) transports were affected by the failure of the elevators which was due to either its mechanical issues or electrical failure. The path through which transport occurred i.e. corridors and hallways was not clear during the transfer of 129 (38.5%) cases. This was noted mostly when the elevators were faulty, and during the visiting hours. The college of intensive care medicine of Australia and New Zealand recommends that the best route for transporting critically ill patients should be well planned, and the lifts secured or reserved beforehand.[63][64] The corridors and the elevators should be made clearer and booked respectively before departure to pave the way and minimize the delays during the transport process.[16]

231 (69%) transports had patient systemic events involving the cardiovascular, respiratory and the central nervous system. The respiratory and cardiovascular system were the most commonly affected organs representing 63 (18.8%) and 59 (17.6%) respectively. Most patients had more than one system affected. 11 (3.3%) transports had three organ systems affected: the cardiovascular, the respiratory and the central nervous system. The respiratory system events included tachypnea, desaturation, difficulty in breathing, and copious secretions. The cardiovascular system events included tachycardia, bradycardia, hypertension, and hypotension. The most common central nervous system adverse events reported were the deterioration in the level of consciousness and convulsions. Others were confusion, agitation, and shivering.

Handover is vital to the continuation of patient care. The guidelines advocate for the documentation of the patient's clinical status in the clinical record during transport until handover occurs at the receiving unit.[63][64] All critically ill patients transported to the critical care units had the correct identity during handing over process and their transfer notes were well documented by either the transport nurse or physician/ non-physician or both. The transfer notes were documented by the transport nurse and the physician/ non-physician in 301 (89.9%) and 160 (47.8%) of the transports respectively. The guidelines on intra-hospital transport of critically ill patients recommend that the patient's general condition, progress, and management during transport should be documented and filed in the patient's medical record and copies provided to the receiving unit.[63][64] The correct patient identity and full documentation of medical records and investigation reports when handed over in an organized manner have been shown to prevent the loss of information.[27][32]

6.1 Conclusions

KNH lacks dedicated transport teams and transport equipment for IHT of critically ill patients. In addition, there is a lack of formal pre-transfer checklist documentation, a dedicated emergency trolley, airway equipment and monitor for use during the IHT of patients. There was inadequacy reported in the monitoring and composition of the transport team but there were no adverse outcomes reported.

6.2 Recommendations

There is a need for formulating an objective pre-transfer checklist document which can be filled during the transfer of patients within the hospital. In addition, there is a need to have dedicated transport teams, monitoring equipment a portable transport ventilator and a portable defibrillator. KNH also needs to conduct regular audits on the practice of transfer of critically ill patients in order to identify areas of weakness for constant improvement and formulate protocols and guidelines for use during the transfer of critically ill patients.

6.3 Study limitations

1. Reporting and recall bias occurred when the clinicians do not remember the previous events or experiences accurately before, during and after transfer and as a result report inaccurate information and omit some important details that would have been beneficial to the patient's care.
2. It was difficult to associate the patient adverse events during transport with the equipment related challenges due to the wide variations of the primary diseases of the patient

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APPENDICES

Appendix 1: Time Frame

Activity	**Period**
Proposal writing	May 2016 - July 2017
Proposal discussion with supervisors	August - December 2017
Proposal presentation to the department	January - February 2018
Seeking Ethical approval	March-June 2018
Data collection	June - September 2018
Data analysis and report writing	September 2018 – May 2019
Discussion of results with supervisors and presentation of study findings to the department	May – June 2019

Appendix 2: The informed consent for the service providers

A CROSS-SECTIONAL STUDY ON CHALLENGES OF INTRAHOSPITAL TRANSPORT OF CRITICALLY ILL PATIENTS TO KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNITS.

Introduction

I, Dr. Obadiah K. Samoei is currently pursuing a postgraduate degree in Anesthesia and Critical Care. As part of my postgraduate program requirements, I am conducting a study to establish the challenges during intra-hospital transfer of critically ill patients into Kenyatta National Hospital Critical Care Units.

Purpose of the study

The objective of the study is to identify the equipment, transport team, and infrastructure related challenges during intra-hospital transfer of critically ill patients to KNH Critical Care Units.

Study procedures

Upon arrival into the critical care unit and the consenting procedure has been undertaken, information will be collected inform of a questionnaire.

Participation in the study

Your participation in the study is entirely voluntary and you are free to withdraw from it at any stage without any penalty.

Study approval

This study will be conducted with the approval of the KNH/UON ethics and research committee.

Risks

By participating in this study you will not be exposed to any additional risks.

Benefits

The findings from this study will help improve the care of the patient during intra-hospital transfer of critically ill patients to Kenyatta National Hospital Critical Care Units.

Confidentiality

Your identity and information collected from this study will be protected with utmost confidentiality and personal details will not be recorded in the data collection tool. Information about you will have your initials to which a serial number will be assigned instead of your name.

Contacts

For any clarifications or queries about the study, you can contact the following people;

1. Dr. Samoei K. Obadiah: 0720336436 or email: obashk4@gmail.com
2. Supervisor's contacts:

- Prof. Ngumi: 0722218921 or email: zngumi@gmail.com
- Dr. Mwangi: 0721546600 or email: carlomwa@yahoo.com
- Dr. Chikophe: 0721436926 or email: idris6664@gmail.com

3. KNH-UoN ERC Secretary Contact telephone numbers 2726300 ext. 44102, email uonknh_erc@uonbi.ac.ke

Thank you.

Consent form for the service provider.

I accept to take part in the study entitled **"A CROSS-SECTIONAL STUDY ON CHALLENGES OF INTRAHOSPITAL TRANSPORT OF CRITICALLY ILL PATIENTS TO KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNITS".**

I ……. have read and understood the explanations of this study. I have not been coerced or enticed with any benefits, and I fully understand that this study will have no harmful effects on the participants and that confidentiality will be maintained. I also understand this is a voluntary exercise and that I may choose to withdraw from the study at any stage without any risk of victimization.

I hereby give my informed consent.

Participant's Signature……..

Researcher's Signature……..

SHEMA YA 1

MAELEZO YA KIBALI YA WATAJI WA UTUMIZI

UCHUNGUZI TAFITI KUHUSU UTEKELEZAJI WA UHAMISHO WA WAGONJWA MAHUTUTI KUELEKEA CHUMBA CHA WAGONJWA MAHUTUTI KATIKA HOSPITALI YA KITAIFA YA KENYATTA.

Utangulizi

Majina yangu ni Dk. Obadiah K. Samoei kwa sasa ninafuatilia shahada ya shahada ya kwanza katika Anesthesia na Critical Care. Kama sehemu ya mahitaji yangu ya mpango wa daraja, ninafanya uchunguzi tafiti kuhusu utekelezaji wa uhamisho wa wagonjwa mahututi kuelekea chumba cha wagonjwa mahututi katika hospitali ya kitaifa ya Kenyatta.

Kusudi la utafiti

Lengo la utafiti ni kutambua vifaa, timu ya usafiri na changamoto zinazohusiana na miundombinu wakati wa uhamisho wa wagonjwa mahututi kuelekea chumba cha wagonjwa mahututi katika hospitali ya kitaifa ya Kenyatta.

Njia za kujifunza

Baada ya kuwasili katika kitengo cha utunzaji muhimu na utaratibu wa kukubaliwa umefanyika, taarifa zitakusanywa kwa dodoso.

Kushiriki katika utafiti

Kushiriki kwako katika utafiti ni kikamilifu kwa hiari na wewe ni huru kuondoka kutoka utafiti wakati wowote bila adhabu yoyote.

Pata kibali

Utafiti huu utafanyika kwa idhini ya KNH / UON ERC

Hatari

Kwa kushiriki katika utafiti huu hutapata hatari yoyote ya ziada.

Faida

Matokeo ya utafiti huu itasaidia kuboresha utunzaji wa mgonjwa wakati wa uhamisho wa wagonjwa mahututi kuelekea chumba cha wagonjwa mahututi katika hospitali ya kitaifa ya Kenyatta.

Usiri

Utambulisho wako na habari zilizokusanywa kutoka kwenye utafiti huu zitahifadhiwa kwa usiri mkubwa na maelezo ya kibinafsi hayatarejeshwa kwenye chombo cha kukusanya data. Habari kuhusu wewe itakuwa na maandishi yako ambayo nambari ya serial itapewa badala ya jina lako.

Mawasiliano

Kwa ufafanuzi wowote au maswali kuhusu utafiti, unaweza kuwasiliana na watu wafuatayo;

1. Dk. Samoei K. Obadiah: 0720336436 au barua pepe: obashk4@gmail.com

2. Msaidizi wa mawasiliano:

• Prof. Ngumi: 0722218921 au barua pepe: zngumi@gmail.com

• Dr Mwangi: 0721546600 au barua pepe: carlomwa@yahoo.com

• Dr Chikophe: 0721436926 au barua pepe: idris6664@gmail.com

3. Katibu wa KNH-UoN ERC Namba ya simu ya simu 2726300 ext. 44102, barua pepe uonknh_erc@uonbi.ac.ke

Asante

Fomu ya kibali kwa mtoa huduma.

Nakubali kushiriki katika utafiti ulio na kichwa **“UCHUNGUZI TAFITI KUHUSU UTEKELEZAJI WA UHAMISHO WA WAGONJWA MAHUTUTI KUELEKEA CHUMBA CHA WAGONJWA MAHUTUTI KATIKA HOSPITALI YA KITAIFA YA KENYATTA”.**

Mimi ..... nimeisoma na kuelewa maelezo ya utafiti huu. Sijawahi kulazimishwa au kuvutiwa na faida yoyote, na ninaelewa kikamilifu kwamba utafiti huu hautakuwa na madhara kwa washiriki na kwamba siri itahifadhiwa. Pia ninaelewa hili ni zoezi la hiari na kwamba nipate kuchagua kujiondoa kwenye somo wakati wowote bila hatari yoyote ya unyanyasaji.

Mimi hapa kutoa ridhaa yangu ya ufahamu.

Ishara ya Mshiriki .....

Saini ya Mtafiti .....

Appendix 3: Waiver of consent and waiver of consent documentation

I would like to apply for the waiver of consent and waiver of documentation of consent for the following reasons:

Transport of critically ill patients into the Critical Care Unit (CCU) usually occurs in emergency circumstances and obtaining informed consent is not feasible as a result of their critical medical condition. The prompt transport and intervention required provide insufficient time and opportunity to locate and obtain consent from each subject's legally authorized representative (LAR).

In addition, the research involves no more than minimal risk to the participants. The waiver of consent will not adversely affect the rights and welfare of the participants and participation in the research will be beneficial, as the findings will help develop written protocols on intra-hospital transport into the CCU that may improve patient outcomes

My responsibilities as the primary investigator will include:

To try to locate the subject's legally authorized representative or contact a family member to determine whether the family member objects to the subject's participation.

To avail detailed information and seek verbal consent from the legally authorized representative or next of kin, whenever possible. If the LAR will not be physically available to give verbal consent then the primary investigator will indicate that the consent was acquired over the phone.

To protect identifiers from improper use and disclosure.

Appendix 4: Questionnaire

PATIENT INITIALS……SERIAL NUMBER……..

GENDER...……...AGE……

DATE OF TRANSFER…….……..

DIAGNOSIS……

PATIENT TRANSFER INFORMATION

1. REASONS FOR TRANSFER (Tick as appropriate)

☐ Respiratory support ☐ Cardiovascular support ☐ Low neurological status

☐ Metabolic derangement ☐ Elective post op monitoring ☐ Intra-operative event

☐ Delayed awakening postoperatively ☐ Postoperative event in Post Anesthetic Care unit

☐ Others (specify) ……

2. SITE OF ORIGIN (Tick as appropriate)

A). Accident and emergency department ☐

B). Wards

i). Surgical:

☐ General surgery ☐ Neurosurgery ☐ Cardiothoracic ☐ Orthopedics

☐ Gynecology and Obstetrics ☐ Ear Nose Throat ☐ Eye ☐ Burns ☐ Pediatrics

ii). **Medical:**

☐ General medical ☐ Pediatrics ☐ Oncology

C). Theatre

i). Elective

☐ Cardiothoracic ☐ Neurosurgery ☐ Orthopedics ☐ General Surgery

☐ Gynecology and Obstetrics ☐ Ear Nose Throat ☐ Eye ☐ Neurosurgery

☐ Burns

ii). Emergency:

☐ Trauma ☐ Maternity ☐ Other (specify)….....

D). Other (specify) ……..

3. TRANSFER DESTINATION (Tick as appropriate)

☐ Main critical care unit (CCU) ☐ Medical intensive care unit (MICU)

☐ Pediatric intensive care unit (PICU) ☐ Other (specify) ……

4. PRETRANSFER PREPARATION (Tick as appropriate)

Was the patient's clinical condition communicated to the receiving unit? ☐ NO ☐ YES

If YES, indicate the time of communication……

Time of departure….....

5. MODE OF TRANSPORT (Tick as appropriate)

☐ Wheel chair ☐ Stretcher ☐ Carried by relative/hospital personnel

☐ Hospital bed/cot ☐ Other (specify) ……

6. ACCOMPANYING PERSONNEL

Tick as appropriate the presence of the following accompanying personnel.

i). Nursing staff ☐ YES ☐ NO Indicate their number.....

C**adre:** Qualified nurse ☐ YES ☐ NO Student nurse ☐ YES ☐ NO

Critical care trained ☐ YES ☐ NO

ii). Physician/Non-physician ☐ YES ☐ NO Indicate their number……

Cadre:

Consultant ☐ Clinical officer ☐ Medical officer Intern ☐

Medical officer ☐ Resident doctor ☐ Clinical officer Intern ☐

iii). Presence of the following:

☐ Physiotherapist ☐ Paramedic ☐ Porter ☐ Relative ☐ Others (specify)..……

7. MONITORING MODALITIES PRESENT DURING TRANSPORT

Tick as appropriate any of the following monitoring parameter during transport.

☐ Pulse oximeter ☐ Intracranial Pressure ☐ End-tidal Carbon dioxide

☐ Non-invasive blood pressure ☐ Invasive blood pressure ☐ Heart rate

☐ Electrocardiogram ☐ Respiratory rate ☐ Central venous pressure

☐ Temperature ☐ None ☐ Other (specify)……

8. MEDICATION DURING TRANSPORT (Tick as appropriate)

☐ Inotropes ☐ Sedatives ☐ Muscle relaxants ☐ Intravenous fluids

☐ Others (specify) ……..

9. EMERGENCY TROLLEY:

a). Was there an emergency trolley during transport? ☐ NO ☐ YES

b). Tick as appropriate the presence of the following during transport.

Bag valve Mask (Ambu bag) ☐ YES ☐ NO

Laryngoscope ☐ YES ☐ NO

Stethoscope ☐ YES ☐ NO

Basic resuscitation drugs ☐ Adrenaline ☐ Atropine ☐ Dextrose ☐ Bicarbonate

☐ Calcium gluconate ☐ None ☐ Others (specify)….....

Definitive airway: ☐ Endotracheal Tube ☐ Tracheostomy

Airway Adjuncts: ☐ Oropharyngeal Airway ☐ Nasopharyngeal Airway

☐ Supraglottic devices (IGEL/Laryngeal mask airway)

Other (Specify) …….

10. STATUS OF THE PATIENT DURING TRANSPORT (Tick as appropriate)

A). Airway: Was the patient on oxygen? YES/NO…….. If YES, tick as appropriate:

☐ Intubated ☐ Face mask ☐ Nasal prong ☐ Laryngeal mask airway

☐ Ventilation mask

B). Breathing

☐ Manual Ventilation ☐ Transport ventilator ☐ Spontaneous ☐ T-Piece

C). Lines Present

☐ Peripheral Venous Access ☐ Central Venous Access ☐ Arterial line ☐ None

D). Tubes Present

☐ Urethral Catheter ☐ Dialysis Catheter ☐ External ventricular drainage

☐ Nasogastric tube ☐ Drains (specify)… ……. ☐ None

E). Immobilisation devices

☐ Cervical collar ☐ Thomas splint ☐ Other (specify) …… ☐ None

11. EVENTS DURING INTRAHOSPITAL TRANSPORT

A). Patient systemic events during transport (Tick as appropriate)

Central nervous system ☐ YES (specify) ……. ☐ NO

Respiratory ☐ YES (specify) ……. ☐ NO

Cardiovascular ☐ YES (specify) ……. ☐ NO

Other (specify) ……

B). Equipment related events (indicate as appropriate)

Monitoring: Present YES/NO……Working YES/NO…….

Ventilator: Present YES/NO……..….Working YES/NO…….

Infusion pumps: Present YES/NO……..…Working YES/NO……..

Intubation equipment: Present YES/NO……Working YES/NO….....

Oxygen cylinder: Present YES/NO……Oxygen failure YES/NO…….

Bed-related problems (Caster without locks, side rail latches, braking mechanism, check valves,

Headspring YES/NO……...…….

Other (specify)…….

c). Infrastructure (indicate as appropriate)

Elevator: Working YES/NO……

Electricity failure YES/NO……..

Clear pathways/corridor YES/NO….....

Other (specify)…….

12. HANDOVER (Tick as appropriate)

What time did the patient arrive at ICU? ……..

Is the patient identity correct? ☐ YES ☐ NO

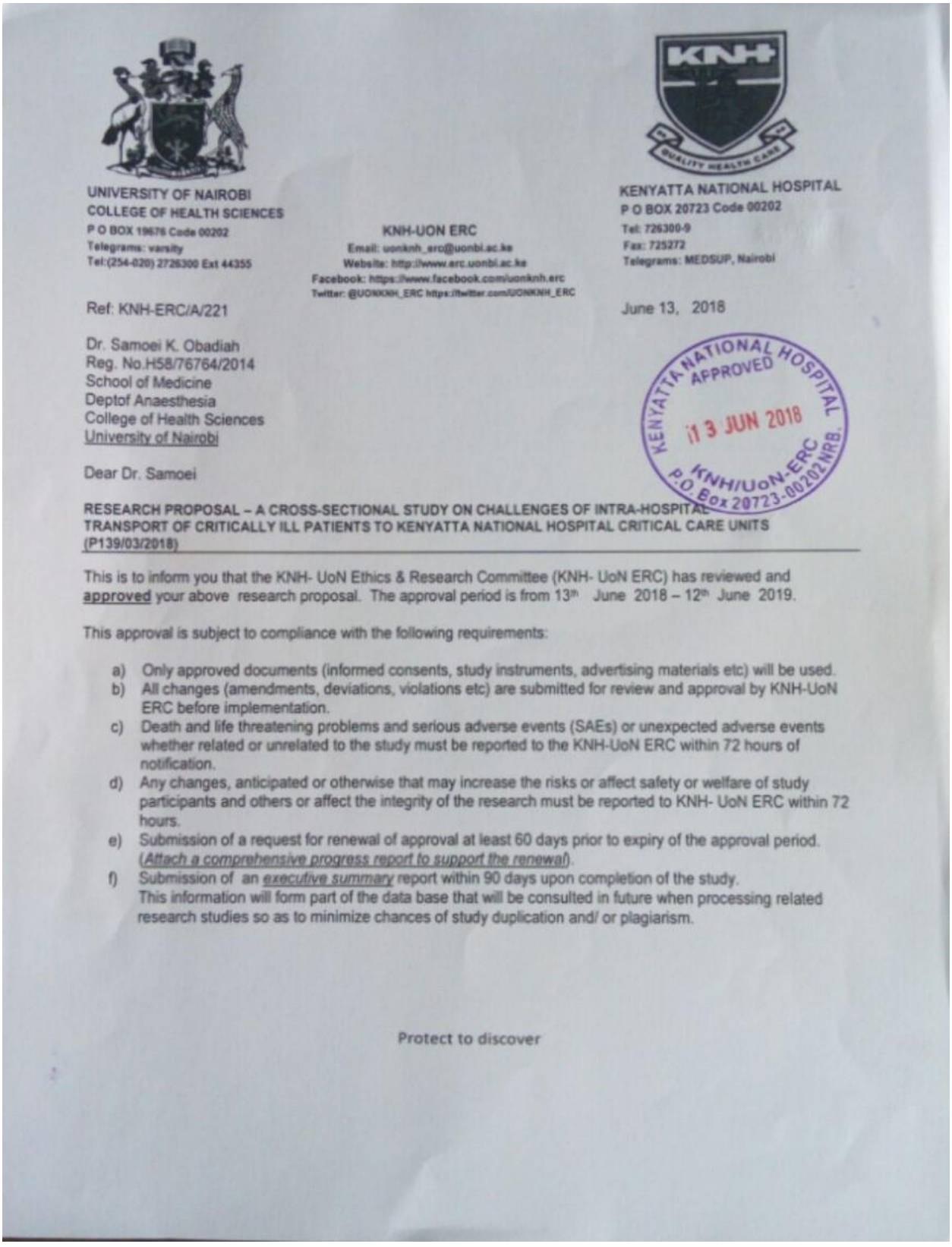
Is the patient transfer notes documented? ☐ NO If YES by

☐ Nurse ☐ Physician/ Non-physician

Appendix 5: Budget justification

Item	**Total cost (Kshs)**
Biostatistician	30,000
Research Assistant	55,000
Stationery and related printing	10,000
Internet hours	6,000
KNH/UoN ERC Fee	2,000
Phone calls cost	6,000
Training cost	2000
Miscellaneous	3,000
Subtotal	114,000
10% contingency	11,400

Appendix 6: Ethical approval form



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Ref: KNH-ERC/A/221

June 13, 2018

KENYATTA NATIONAL HOSPITAL APPROVED 13 JUN 2018 KNH/UoN-ERC P.O. Box 20723-00202 NRB.

Dr. Samoei K. Obadiah
Reg. No.H58/76764/2014
School of Medicine
Deptof Anaesthesia
College of Health Sciences
University of Nairobi

Dear Dr. Samoei

RESEARCH PROPOSAL – A CROSS-SECTIONAL STUDY ON CHALLENGES OF INTRA-HOSPITAL TRANSPORT OF CRITICALLY ILL PATIENTS TO KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNITS (P139/03/2018)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and approved your above research proposal. The approval period is from 13th June 2018 – 12th June 2019.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover

For more details consult the KNH- UoN ERC website http://www.erc.uonbi.ac.ke

Yours sincerely,

PROF. M. L. CHINDIA
SECRETARY, KNH-UoN ERC

c.c. The Principal, College of Health Sciences, UoN
The Deputy Director, CS, KNH
The Chairperson, KNH-UON ERC
The Assistant Director, Health Information, KNH
The Dean, School of Medicine, UoN
The Chair, Dept. of Anaesthesia, UON
Supervisors: Prof. Z.W.W. Ngumi, Dr. Idris Chikophe, Dr. Caroline Mwangi

Appendix 7: Antiplagiarism certificate

Submission date: 10-Jul-2019 05:14PM (UTC+0300)
Submission ID: 1150741847
File name: OBADIAH_KIPKOECH_SAMOEI.docx (1.44M)
Word count: 8010
Character count: 46865

A CROSS-SECTIONAL STUDY ON CHALLENGES OF INTRAHOSPITAL TRANSPORT OF CRITICALLY ILL PATIENTS TO KENYATTA NATIONAL HOSPITAL CRITICAL CARE UNITS.

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