



SCHOOL OF MEDICINE
DEPARTMENT OF INTENSIVE CARE MEDICINE

A QUANTITATIVE PROSPECTIVE STUDY

ON

ADVERS EVENTS OF INTRAHOSPITAL TRANSPORT AMONG
CRITICALLY ILL PATIENTS AT SP.PAUL'S HOSPITAL MILLENIUM MEDICAL
COLLEGE AND AaBET HOSPITAL ADULT INTENSIVE CARE UNIT

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List of abbreviations

AaBET	Addis Ababa Burn, Emergency and Trauma.
ASA	American Society of Anesthesiologists
CCU	Critical Care Unit.
ECG	Electrocardiogram
ERC	Ethics and Research Committee.
FiO ₂	Fractional inspired oxygen concentration.
ICU	Intensive Care Unit
IHT	Intra-hospital transport
SaO ₂	Arterial Oxygen Saturation
SPSS	Statistical Package for the Social Science.

Abstract

Background: Intra-hospital transport of critically ill patients is unavoidable and is associated with an increased risk of adverse events, which may compromise patient safety. Previous studies have reported that 22%–68% of transported high-risk patients develop cardiovascular complications such as arrhythmias. Despite this, there is limited local evidence describing the Magnitude and pattern of adverse events during Intra hospital transport in Ethiopian tertiary hospitals

Objective: To asses Adverse events during Intra hospital transport of critically ill patients to St.paul' Hospital Millennium Medical College and Addis Ababa Burn, Emergency, and Trauma AaBET Hospital adult Intensive care unit.

Methodology: This was a multicenter prospective cross-sectional study conducted among critically ill patients undergoing intra-hospital transport at St. Paul's Hospital Millennium Medical College and Addis Ababa Burn, Emergency, and Trauma Hospital adult Intensive care unit.

Data was collected using a self-administered questionnaire filled by assigned data collector, then It was entered and analyzed by the use of SPSS version 26 and the findings was presented in the form of tables, pie charts, and graphs.

Result: Among 361 transported ICU patients, 71.7% were male, with a mean age of 44.1 years. Most transfers were from the Emergency Room during daytime on weekdays. Respiratory and cardiovascular support was the most common reason for admission. Four to five personnel, mainly nurses, conducted transfers. Vital sign monitoring was used in most cases, with 25% of patients requiring manual ventilation Adverse events occurred was, cardiovascular (arrhythmia) and neurological.

Conclusion and Recommendation: Intra-hospital transport of critically ill patients was generally safe, with a low incidence of adverse events. However, the occurrence of cardiovascular and neurological complications highlights the need for , Strengthening continuous monitoring, ensuring the availability of appropriate equipment, providing regular training for transport teams, and adhering to standardized transport protocols are essential to further minimize adverse events and improve patient safety.

Keywords: Intra hospital transport, critical ill patients, adverse events, patient transportation

1. 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 (ICU).

An Intensive Care Unit (ICU) is defined as a specialized hospital department where critically ill patients receive intensive treatment and continuous monitoring via advanced medical equipment and expert staff, as detailed in studies from India(20,25) and Brazil(2,3). Within this environment, Intra-hospital transports the unavoidable movement of patients between departments for diagnostic or therapeutic interventions.

Subsequent research has shown that adverse event incidence varies broadly from 1.7% to 75.7% depending on the specific definitions used, according to a study from Brazil, 2015 and a study from India, 2014. Despite this wide statistical range, these incidents are consistently categorized into domains involving the patient's clinical status, technical equipment, staffing competencies, and the hospital environment(4,5).

An audit in a study from Australia, found that 62% of IHT cases involved complications, with 45% stemming from equipment or environmental factors—such as battery exhaustion, mechanical malfunctions, and circuit disconnections—while 31% were patient-related, including hemodynamic instability, oxygen desaturation, and increased intracranial pressure (2,6).

Furthermore, human error remains a critical variable, contributing to over 50% of incidents; while studies from Egypt, 2023 and Rwanda ,2019 show that staff generally maintain positive attitudes toward safety, actual clinical practice often reveals gaps in standardized knowledge (7,8).

Despite this, there is limited local evidence describing the Magnitude and pattern of adverse events during Intra hospital transport in Ethiopian tertiary The purpose of this study is to asse Adverse events during intra hospital transport in St. St. Paul's Hospital millennium medical college and AaBET Hospital Adult ICU and compare to recognized safety standards.

1. Statement problem and Significant of the study

Intra hospital transfer of critically ill patient is a crucial part of patient care. It has major bearing on patient outcome therefore has to be performed in standardized manner. Emergency room ,Or, Ward and Opd are the main catchment area of this patients.

Despite higher number of patient admission there are no adherences in using standardized written protocols that are used during the transfer of these patients.

Transfer of critically ill patients is done during emergency setting: this is associated with increased risks for complication related to changes of patients physiological states, transport team dynamics, equipment and monitoring challenges and hospital design and infrastructure challenges.

So there is need to establish the magnitude and patterns of adverse events of Intra hospital transport of critically ill patients in our settings Witch has never been done before. So the finding from this study will help to identify adverse events of critically ill patients.

The inferences from this study will increase the body of knowledge on IHT and may form the basis for adherence to intra hospital transport protocol and further research

2. Literature review

Critically ill patients are at high risk of clinical deterioration. Such deterioration may occur in hospital wards, outpatient clinics, operating rooms, or the emergency department, and these patients may therefore require transport and admission to ICU.

During transport to the ICU, appropriate monitoring and organ support must be maintained to ensure patient safety and stability.

During intra-hospital transport, critically ill patients require continuous monitoring and adequate organ support to maintain physiological stability and prevent deterioration. The intensive care unit (ICU) offers an optimal setting for advanced monitoring and comprehensive management of these patients. However, the process of transporting patients to the ICU represents a vulnerable period, as interruptions in monitoring, limited resources, and environmental factors may increase the risk of adverse events (1,10,11). Therefore, understanding and minimizing these risks is essential to improve patient safety during transport.

Intra-hospital transport must be conducted in a manner that provides the safest and most adequate monitoring using the minimum amount of equipment due to space limitations. The primary objective of intra-hospital transport is to provide safe transfer of critically ill patients by ensuring continuity of care, constant monitoring, and necessary interventions, as maintaining continuous monitoring is essential to prevent adverse events and physiological decline (3,7).

The minimum standards for monitoring during the transport of critically ill patients include continuous oxygen saturation(3,5). electrocardiogram (ECG), non-invasive blood pressure, respiratory rate, and heart rate. Other supplementary modalities like scenography and invasive monitoring for arterial blood pressure, central venous pressure (CVP), pulmonary artery pressure, and intracranial pressure can be utilized depending on clinical status, while oxygen supply and ventilator settings must be monitored in all mechanically ventilated patients, as noted in studies from Brazil and India (1, 3, 4).

Most equipment-related adverse events involve disconnections, power malfunctions, or supply failures; power malfunctions, and supply failures. For instance, the failure of a suction apparatus during an accidental extubation can result in catastrophic outcomes, particularly in patients with compromised airways. Evidence from multicenter research in India indicates that equipment-related mishaps—including problems with transport ventilators, monitors, and battery exhaustion—continue to be a significant barrier to safe IHT.(1, 12)

A study identified that 39% of all IHT-related incidents were equipment-based, with airway-specific issues such as endotracheal tube obstruction or malposition contributing to severe patient harm and a reported mortality rate of approximately (2). Furthermore, research highlights that while patient-related physiological changes are common; up to one-third of all transport mishaps are strictly equipment-related, often involving portable ventilators and infusion pumps. These findings underscore the necessity of pre-transport checklists to ensure equipment functionality and battery adequacy before moving critically ill patients (5,13,14).

Research conducted in the USA (2007) reported a 69.7% incidence of adverse events during transport from the emergency department, with nearly half associated with ventilation and artificial airways, as cited in a study from Turkey (2020). Additionally, a study from Australia (2020) estimated an adverse event rate of 22%, where 9% related to equipment failure and 4.5% to uncharged batteries, resulting in cardiorespiratory arrest (2, 14–16).

To reduce these difficulties, the displays of all monitors and ventilators should be accessible and visible to escorting staff, as recommended in a study from India (2025). Equipment-related events can be minimized through pre-transport checks, alarm resetting, and regular calibration, while power failure risks are reduced by using lithium batteries and connecting to power sources promptly, according to studies from Egypt (2023) and Kenya (2014). Finally, a study from Brazil (2015) suggests that adapted transport equipment with safeguarding parts should be used to prevent the tangles and knots that lead to line disconnections.(5,17–19)

A landmark study from India (2025) emphasizes that critically ill patients are at high risk of physiological deterioration during intra hospital transport (IHT) due to a combination of equipment failures, patient-related instabilities, and environmental factors. To standardize risk assessment, researchers categorize these complications by severity: minor events are often

defined as a 20% fluctuation in physiological parameters compared to the patient's pre-transfer baseline. In contrast, serious incidents involve life-threatening situations requiring immediate, life-saving intervention—such as cardiac arrest or unplanned extubation—as detailed in foundational reviews. Furthermore, various studies from India and Brazil report that cardiac arrest occurs in 0.34% to 1.6% of transported patients. A study from Germany established a correlation between minor adverse events and the severity of illness as measured by the APACHE II score, though no such association was found for severe adverse events; however, the global incidence of adverse events increased significantly when transport was conducted in an emergency context rather than an elective one (1,2,5,12)

A study from the USA (2007) notes that serious adverse events are largely due to the severity of the patient's clinical condition. Most systemic events encountered during transfer involve the cardiovascular, respiratory, and central nervous systems, including hemodynamic disturbances like arrhythmias and blood pressure fluctuations that can be mitigated through stabilization before transport. Finally, a study from Australia (2004) reported that 42.5% of adverse events—including severe hypotension, arrhythmias, and declining neurological status—occur during emergency transport when the patient's condition is rapidly (2, 17,20).

Intra-hospital transport team:

A study from India emphasizes that the transport team plays a crucial role in patient transfer and should consist of at least one qualified, trained nurse and a medical practitioner. These professionals require specific knowledge in managing critically ill patients and requisite skills in transport to provide the highest quality and safest level of care, as noted in studies from Egypt (2 and India (2014)).(3, 6,7)

Human errors contribute to 54% of transport incidents, often due to inexperience, errors of judgment, poor problem recognition, inattention, and failure to follow protocols or prepare equipment. To mitigate these risks, a study from Brazil (2012) suggests that the use of pre-transfer checklists and the provision of highly qualified staff are essential (2).

Specifically, research in a study from the USA demonstrated a higher adverse event rate when transports were led by junior and senior residents compared to experienced emergency physicians. However, a study from Germany found no such increase in adverse events among

junior doctors, provided they had received sufficient training and utilized equipment specifically designed for transport purposes (2,13,19).

Environmental factors: affecting intra-hospital transport.

Environmental factors play a crucial role during the transport process, as an uncontrolled environment exposes critically ill patients to hazards such as temperature fluctuations and noise pollution. It is estimated that nearly 70% of all intrahospital transports involve some form of adverse event, with environmental and equipment factors contributing to approximately 30% of these incidents (18,21,22).

These physical forces can significantly interfere with monitoring and physiological stability, particularly in traumatic brain injury patients requiring strict intracranial pressure control . It is estimated that patient-related and environmental factors, including the physical stressors of the route, contribute to approximately 70% of the physiological alterations observed during transport (22,23).

Navigating such environments also increases the risk of patient mal-positioning, which may lead to the accidental disconnection of tubing and a subsequent worsening of clinical status. To mitigate these risks, a study from India (2014) recommends that corridors be cleared and elevators booked in advance of departure to ensure a smooth path and minimize delays during the transport process.(3, 23)

Intra-hospital transport Guidelines and protocols

The intrahospital transport of critically ill patients is a high-stakes process that demands meticulous decision-making, rigorous planning, and precise implementation. As highlighted in research conducted in India 2023, a "safety first" approach is paramount, requiring clinicians to perform a thorough risk-benefit analysis before every move. The primary goal is to ensure that the transport does not exacerbate the patient's condition. Therefore, achieving physiological stabilization—particularly for those with respiratory or hemodynamic instability—must be the priority before leaving the safety of the ICU or emergency department, a principle strongly advocated in evidence-based guidelines from Ethiopia.(3, 6)

To mitigate the risk of unexpected incidents, hospitals must adopt well-designed transport protocols and systematic checklists. Studies from Brazil, 2015 and Portugal 2020 demonstrate that checklists act as essential safety barriers, ensuring that resuscitation kits, monitoring equipment, and patient documentation are verified before transit. The dangers of bypassing these steps are evident in research from South Africa, 2020, where a high incidence of adverse events—such as hypotension and equipment failure—was linked to insufficient pre-transport preparation and the level of staff seniority.(5,20,24)

Furthermore, the conduct of intrahospital transport has evolved significantly following updated recommendations from international critical care societies. Modern standards emphasize the importance of continuous monitoring and the presence of specialized staff. In France, 2013, it was found that even with multidisciplinary teams, adverse events remained common, reinforcing the need for strict adherence to institutional standards and the use of dedicated transport equipment. Ultimately, as noted in studies from Rwanda, 2023, the success of these transfers depends heavily on the knowledge and attitudes of the nursing staff and their commitment to following standardized protocols to bridge the "gap in care" during transit (10, 11).

Communication during intra-hospital transport and the handover process

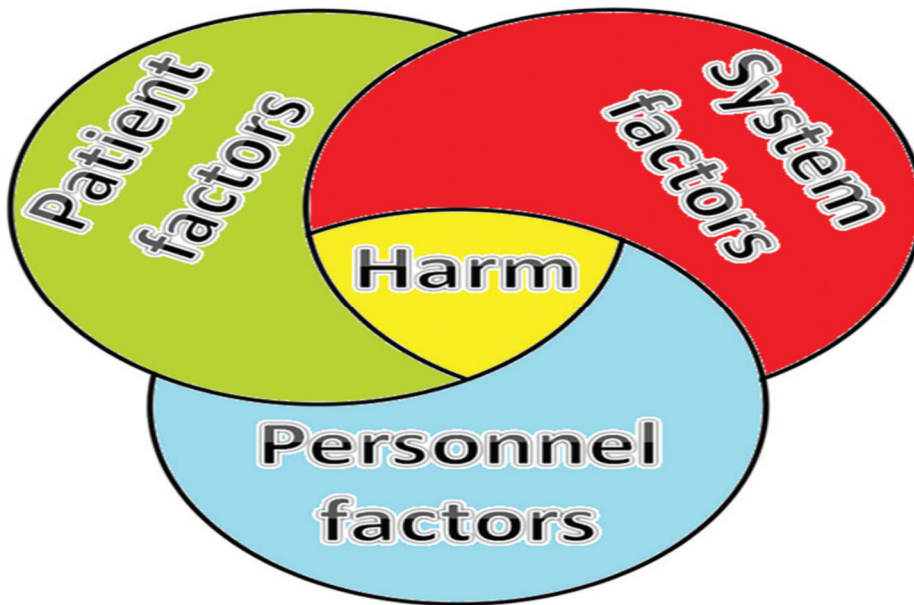
Effective communication during intra hospital transfer of critically ill patients is a fundamental pillar of safety, as it directly influences both the efficiency of the move and the incidence of adverse events. Research conducted in France (2013) highlights that coordination between teams is essential to mitigate the inherent risks of transport, where any breakdown in the exchange of information can lead to significant clinical instability (25).

Miscommunication regarding a patient's clinical status and poor documentation remain pervasive challenges. These errors often stem from a lack of professional knowledge or the high frequency of handovers between caregivers. In Brazil (2012), it was demonstrated that communication failures and inadequate team preparation are primary contributors to complications during transport. Furthermore, evidence-based guidelines from Ethiopia (2021) emphasize that a structured handover is mandatory to ensure the continuity of care, noting that a lack of standardized protocols often leads to "data loss" that compromises patient management (1,2).

The impact of these gaps is significant. In South Africa (2020), studies have shown that technical and clinical adverse events are often exacerbated by poor coordination, where the seniority and experience of the staff play a protective role. To bridge these gaps, recent reviews suggest the implementation of standardized safety tools. For instance, research in Portugal and Brazil advocates for the use of scoping-review-based checklists to provide a structured approach to the handover process, ensuring that critical information—such as airway position and monitoring requirements is accurately conveyed. Ultimately, as noted in studies from Rwanda (2023), the knowledge and attitudes of the nursing staff regarding these communication protocols are the final safeguards in preventing mismanagement during the transfer process (5,20,23,24).

5. Conceptual frame work

Figure 1: Schematic representation of key factors associated with Adverse events during Intra hospital transport of critically ill pts at St. Paul's Hospital millennium medical college and AaBET hospital Adult ICU Adopted from systematic review articles. International Journal of Critical Illness and Injury Science



- A number of patient factors
(e.g ,severity of Illness or injury)
- System factors
(e.g. Equipment deficiencies or failures)
and
- Personnel factors
(e.g., Poor communication)

2. Objective

2.1 General objective

To Assess Adverse events among Intra Hospital Transfer of critically ill patients to St. Paul's Hospital millennium medical college and AaBET hospital adult ICU

2.2 Specific Objectives

- To Assess equipment related Adverse Events during of Intra Hospital Transfer critically ill patients to St .Paul's HMMC and AaBET hospital Adult ICU.
- To Assess transport team related adverse events during Intra Hospital Transfer of critically ill patient to St.paul HMMC and AaBET hospital adult ICU.
- To Assess infrastructure related Advers events during Intra Hospital Transfer of critically ill patients to St. Paul's MMC and AaBET hospital Adult ICU.

3. Method and Materials

3.1 Study design and Study area

A quantitative prospective cross – sectional study of Intra Hospital Transfer of critically ill patients at St. Paul’s mmc and AaBET hospital Adult ICU.

Study area-This study was conducted in the adult Intensive Care Unit (ICU) of St. Paul’s Hospital Millennium Medical College (SPHMMC) and AaBET hospital , located in Addis Ababa, Ethiopia.

SPHMMC and AaBET hospital is one of the country’s largest tertiary referral and teaching hospitals, serving a diverse patient population from across Ethiopia and neighboring regions. It is also the only accredited teaching center for fellowship training in intensive care medicine in the country, making it a pivotal institution for clinical education and research

The adult ICU at SPHMMC and AaBET hospital is a general ICU that manages a wide range of critically ill medical and surgical patients.

The unit is equipped with 24 beds, including advanced ICU specialty beds designed to support complex resuscitation and bedside procedures.

The ICU is functioning 24/7 by trained physicians and nurses, and includes dedicated spaces for clinical operations, staff rest areas, and supply management.

The ICU admits approximately 1,200–1,300 patients annually, with a high proportion which require protocolized intra-hospital transport of critically ill patients to reduce Intra-hospital transport related challenges and adverse events.

Study period is from Aug,1, 2025 to Desember,30,2025,GC.

The selection of SPHMMC as the study site is justified by its high patient volume, advanced ICU infrastructure, dedicated health professionals and institutional commitment to improving patient safety through evidence-based practice. In addition, SPHMMC’s role as a national training hub for health professionals further enhances the relevance and potential scalability of the study findings.

3.2 Sours of population

All critically ill patients transported to the Adult Intensive Care Units of St. Paul's Hospital Millennium Medical College and AaBET Hospital during the study period.

3.3 Study population

All critically ill patients who were transported to the Adult ICUs of St. Paul's Hospital Millennium Medical College and AaBET Hospital during the study period and met the inclusion criteria.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

- All critically ill adult patients transported to the Adult ICU of St. Paul's Hospital Millennium Medical College and AaBET Hospital during the study period.

3.4.2 Exclusion Criteria

- Patients with incomplete transport documentation.
- Patients or legal guardians who did not provide consent

3.5 Sample size determination

The sample size was calculated using sample size formula.

$$n = Z^2 \times P(1 - P) / d^2$$

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 69 %) , from a prospective Cross-sectional Study on Challenges of Intra hospital Transport of Critically Ill Patients by ; Obadiah et al. 2019 over a periods of 14 weeks at Kenyatta National Hospital ICU, found 69% of them were associated

$$d = \text{desired precision (0.05)} \quad n = (1.96)^2 \times 0.7(1 - 0.7) / (0.05)^2 = 325$$

A sample size of 361 critically ill patients to St. Paul's HMMC and AaBET Hospital Adult ICUs was used for the study after adding a 10% Adjusting attrition rate to the initial calculated sample of 325.

3.6 Study Variables

Independent Variable:

- Preexisting Medical Conditions
- Team communication
- Availability of trolley
- V/s derangement.
- Equipment related adverse events
- Handovering and documentation

3.7 Data collection tools and techniques

- A pre-tested structured questionnaire was prepared in English and translated to Amharic language.
- Six Emergency nurses was participated in the data collection.
- The principal investigator and assistance was supervised the data collection process and checked and filled questionnaire for consistency and completeness.

3.8 Data Quality Control

- To assure the quality of the data the following activities was done.
- Training of data collectors
- Questionnaire translation to local language
- Questionnaire pre-testing was done
- The principal investigator and assistants supervised the data collection process, ensuring that all procedures were properly followed, They carefully reviewed the completed questionnaires, checking for consistency and completeness

3.9 Data management and analysis

The collected data were coded and entered into SPSS Statistics Version 26 for analysis. Descriptive statistical methods were employed to summarize the study variables. Categorical variables were described using frequencies and percentages to present the distribution of responses clearly.

3.10 Ethical considerations

- The research proposal was approved by the Institutional Review Board (IRB) of St. Paul's Hospital Millennium Medical College and ABET Hospital
- Written permission was secured from SPHMMC and ABET Hospital to conduct the study.
- All participants was informed about the objective of the study and asked their consent before data collection
- Only the research team had access to the data and all the data was stored in personal devices.

5.11. Dissemination of the result

The study result will be presented to St. Paul's Hospital millennium medical college and AaBET Hospital department of Intensive Care Unit and documents was disseminated to all responsible bodies in the study area, for the hospital where the study is conducted, MOH and St. Paul's HMMC and AaBET Hospital Department of Intensive Care Unit and will be published in international journals

6.Results

Socio- demographic characteristics

A total of 361 participated in the study, with mean ages of 44.1 years, SD 16.85. Males constituted the majority 71.7% (259) and the largest age group was 21–30 years 23.3 % followed by those over 60 years (20.2%). (Table 1)

Table 1: Age and sex distribution of Critically Ill Patients Undergoing Adult ICU Transfer at SPHMMC and AaBET Hospital Adult Intensive Care Units (n = 361)

Age group	gender of respondent		Total	Percent %
	Male	female		
12-20 yrs	14	1	15	3.3
21-30 yrs	64	21	85	23.5
31-40 yrs	56	4	60	16.6
41-50 yrs	38	27	65	18
51-60 yrs	43	20	63	17.5
>60 yrs	44	29	73	20.2
Total	259	102	361	100

With regard to the time of admission, the majority occurred during the daytime (211, 58.4%) and on weekdays (253, 70.1%). (Graph-1)

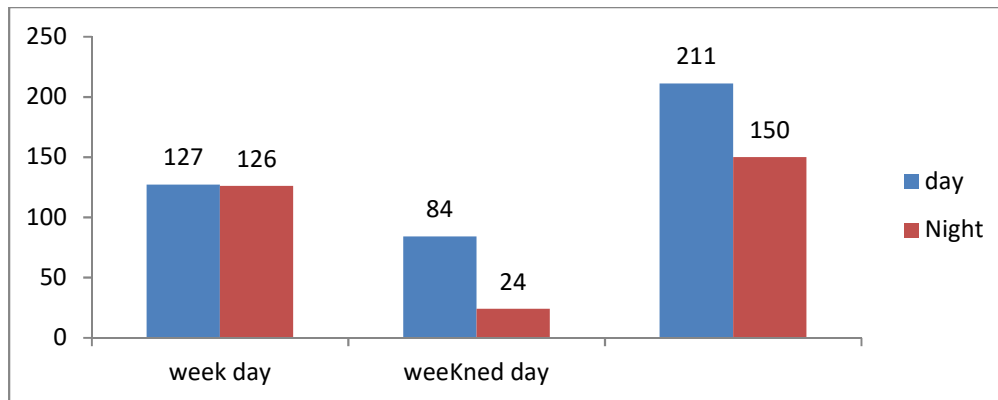


Figure 1; Day and Night Transfer Patterns: Weekday vs Weekend

Site/source of admission

The majority of ICU admissions originated from the Adult Emergency Room (AER), accounting for 58.4% cases (213). This was followed by admissions from the Operating Room (OR) with 78 cases (21.3%), and the general wards with 70 cases (17.2%).

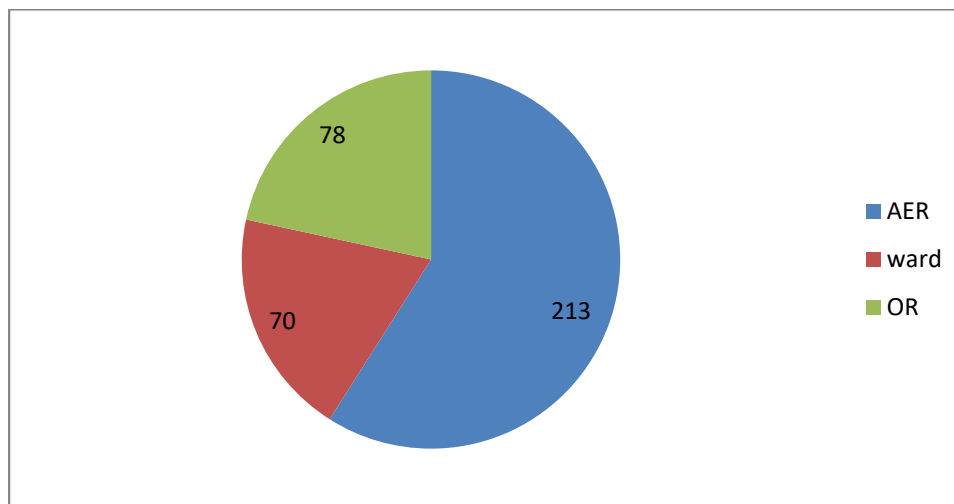


Figure 2; site/ Source of ICU Admissions

Patterns of Organ System Involvement in ICU Admissions

Most ICU admissions were due to single organ system involvement, predominantly respiratory support (132 cases), followed by **Two organ system involvement which was Respiratory and Cardio vascular involvement (107) Cases.**

Table 2; Patterns of Organ System Involvement in ICU Admissions (N=361)

One	Two	Three
POM=4	RS + MD=4	RS+CVS+ MD=8
POAD=24	RS+ CVS=107	
MD=2	RS+ POAD=29	
RS=132	CVS +POAD=5	
CVS=19		
NS=27		

NB: RS: Respiratory Support; CNS: Central Nervous System; MD: Metabolic Derangement; CVS: Cardiovascular Support; POAD= post op awakening delay; POM= post op monitoring; NS=Neurological support

Communication of Patient Condition before Transfer

The patient's condition was communicated in the vast majority of cases. Communication occurred in 96.1%, while 3.9%) the condition was not communicated.

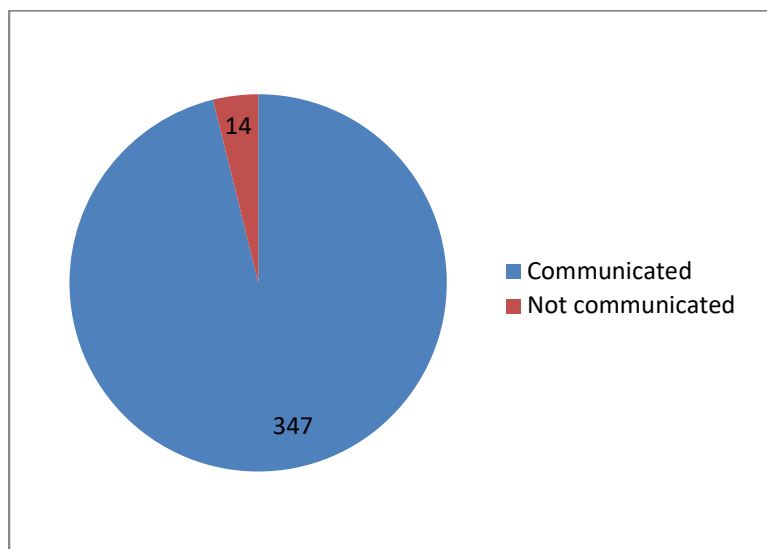


Figure 3; Communication of Patient Condition before Transfer (n=361)

Modes of transportation

Most patients were transported using stretchers, followed by wheelchairs and hospital beds.

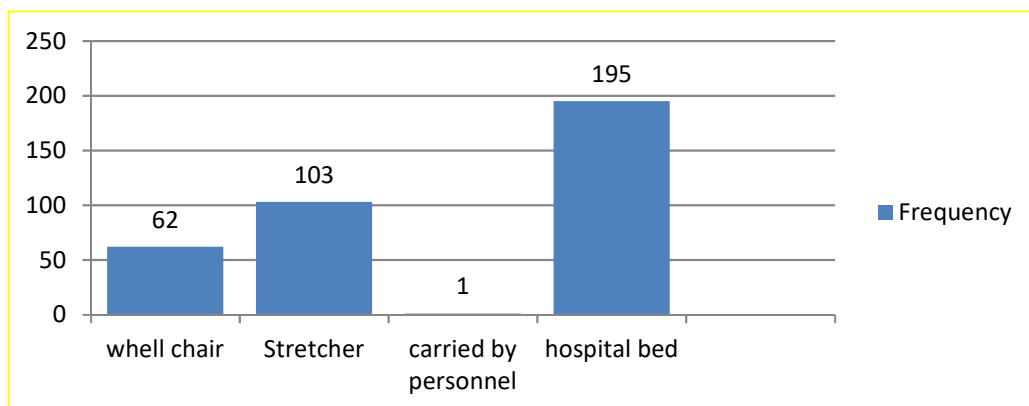


Figure 4- Modes of transportation Transfer (n=361)

Number and Composition of Personnel Involved in Patient Transfers

Most transfers were conducted by four personnel (53.2%), followed by three personnel (26.2%), while transfers with one or two staff members were uncommon. Nurses were the most frequently involved in patient transfers, 82.0% (296), whereas paramedics were the least involved.

Table 3; Personnel Involvement in Patient Transfers

Total Personnel	Team Composition	No. of Patients Transferred
Two	Physician + Resident	1
	Nurse + Porter	1
	Porter + Relative	1
	Nurse + Physician	7
	Nurse + CCN	11
Three	Nurse + Porter + Relative	26
	Nurse + Physician + Relative	18
	Nurse + Physician + Resident	5
Four	Physician + Resident + Porter + Relative	51
	Nurse + Resident + Porter + Relative	11
	Nurse + Physician + Porter + Relative	5
	Nurse + Physician + Resident + Relative	9
	Nurse + CCN + Porter + Relative	5
Five	Nurse + Physician + Resident + Porter + Relative	156
	Nurse + Physician + Resident + CCN + Relative	9
	Nurse + CCN + Physician + Relative + Porter	5
Six	Nurse + CCN + Physician + Resident + Porter + Relative	17
	Nurse + CCN + Physician + Resident + Relative + Paramedic	16
Seven	Nurse + CCN + Physician + Resident + Porter + Relative + Paramedic	1

The number of monitoring modalities during transport

The most frequently used monitoring modality was combination of SPO₂ + RR + HR, applied in 199 transfers (55.1%), followed by SPO₂ alone in 55 transfers (15.2%) . (table-4)

Table 4- The number of monitoring modalities and Resuscitation equipment during transport

<i>Number of personnel (%)</i>				
<i>Monitoring modalities</i>	One	Two	Three	Four
	SPO ₂ =50	SPO ₂ +HR=105	SPO ₂ +RR+	HR+RR+SPO ₂ + T ⁰ =18
	IBP=8		HR=	
	HR=11		199	
	T ⁰ =7			
	NIBP=4			
	RR=6			
<i>resuscitation equipment</i>	S=182	B+S=120	B+S+E=8	
	B=45		B +S+O=6	

NB: RR-Respiratory rate, HR-Heart rate, BP-Blood pressure, SPO₂-Oxygen saturation, T⁰-Temperature IBP-invasive BP NIBP- noninvasive BP S-Stethoscope, B-Bag-Valve Mask, L-Laryngoscope +E-Endotracheal tube, O- Oropharyngeal

Resuscitation drugs during transport

Adrenaline was the most commonly used drug (36.5%). The combination of adrenaline and atropine was used in 6.9%.

Table 5- Resuscitation drugs during patient transport

Resuscitation drugs	Frequency	Percent
Non	175	48.3
Adrenaline	132	36.5
Atropine	14	3.9
Dextrose	7	1.9
Bicarbonate	1	.3

calcium gluconate	8	2.2
Adrenaline & atropine	24	6.9
Total	361	100.0

Airway and breathing status of the patient during transportation

Out of 361 patients, 56.5% (208) were intubated while 43.5% (152) were not intubated. During transfer, 93 (25.8%) patients were on manual ventilation and 104 (28.8%) were on portable vent. (Table 6)

Table 6- Airway and breathing status of the patient during transportation

		N	%
Definitive airway	Intubate	208	56.5
	Tracheostomy	1	
	Not Intubated	152	43.5
Airway adjuvant	Non	19	5.3
	Oropharyngeal	253	70.1
	Nasopharyngeal	1	0.5
	Protected by the patient	88	24.4
Was the pt. on oxygen	Yes	319	88.4
	No	42	11.6
Breathing pattern	Manual ventilation	93	25.8
	Transport vent	104	28.8
	Spontaneous T-piece	3	0.8
Oxygen delivery methods	Intubated	209	57.9
	Face Mask	92	25.5
	Nasal Prongs	25	6.9
	Room Air	35	9.7

Line and tubes of patients during transportation

The majority of patients were transported with peripheral venous access (91.1%), while only a small proportion had central, arterial, or no lines. More than half of the patients had a urethral catheter (56.2%), whereas about one-quarter was transported without any tubes (23.8%), and the remaining tube types accounted for only small percentages.

Table 7- Line and tubes of patients during transportation

Lines and tubes on the patient during transportation		Frequency	Percent
Lines	preferal venous access	329	91.1
	central venous access	4	1.1
	Both Preferal and central access	9	2.5
	arterial line	10	2.8
	Non	9	2.5
Total		361	100.0
Tubes	NON	86	23.8
	urethral catheter	203	56.2
	External ventricular drainage	6	1.7
	NG tube	12	3.3
	Both urinary catheter & NG tube	39	10.8
	Urine & dialysis catheter	10	2.8
	abdominal drainage	3	.8
	chest tube	1	.3
	OG TUBE	1	.3
	Total	361	100.0

Events during intrahospital patient transport

During intrahospital patient transport, the majority of patients (73.4%) experienced no adverse events. The most common events involved the central nervous system (8.6%) and the cardiovascular system (7.2%), while multi-system events were relatively rare (7.3%). Overall, adverse events were uncommon, indicating that patient transfers were largely stable.

Table 8- Events during intrahospital patient transport

No of system involve	System	Frequency	Percent
No	NO	265	73.4
One	CNS	31	8.6
	RS	13	3.6
	CVS	26	7.2
Two	CVS+ RS	10	2.8
Three	CNS+RS+CVS	16	4.5
	Total	361	100

Equipment present during transportation

During patient transport, most patients had oxygen cylinders available (44.0%), while 27.1% were transported without any equipment, and full monitoring or advanced equipment was also used. (Table-9)

Table 9- equipment present during transportation

Equipment present during transportation		Frequency	Percent
No equipment		98	27.1
one	Monitor	5	1.4
	Ventilator	3	.8
	infusion pump	4	1.1
	intubation equip	1	.3
	oxygen cylinder	159	44.0
two	both oxygen & monitor	47	13.0
	MV + oxygen cylinder	36	10.0
three	monitor + intubation equip+ oxygen cylinder	8	2.2
	Total	361	100.0

Infrastructure

No elevator or electricity failures were reported during the transfers, and all pathways and corridors were clear. However, equipment failure occurred in 6 cases (1.7%), while 355 cases (98.3%) had no equipment-related problems. (Table-10)

Table 10- infrastructure

Infrastruction	Frequency n (%)	
	Yes	No
Elevator failure	0	361
Electric city failure	0	361
Equipment failure	6	355
Clear pathways/corridors	0	361

Handover and documentation

Patient identity was correctly confirmed in all cases. Patient transfer notes were documented in 97.2%. Regarding the personnel responsible for documentation, the majority was completed jointly by both nurse and physician/non-physician staff (241 cases, 66.8%).

Table 11- Handover and documentation of patients

Patient handovering and documentation		Frequency	
		Yes	No
Documentation	Patient identity correct	361	0
	Patient transfer notes documented	351	10
Documented by:	Transport Nurse	49	18
	Transport Physician/Non-physician	53	
	Transport Nurse + Physician	241	

5 Discussion

This multicenter prospective cross-sectional study evaluated the adverse events associated with intra-hospital transport (IHT) of critically ill patients to the adult ICUs of St. Paul's Hospital millennium medical college and AaBET Hospital. The findings provide important insight into patient characteristics, transport practices, equipment use, staffing patterns, and the frequency of adverse events in a tertiary hospital setting in Ethiopia.

Socio-demographic Characteristics and Admission Pattern

The majority of transported patients were male (71.7%) with a mean age of 44.1 years. This finding is similar to studies conducted in Brazil (2012), France (2013), **and** Kenya (2019), which also reported male predominance among critically ill patients undergoing intra-hospital transport .Most transfers occurred during daytime hours and on weekdays, likely due to the higher volume of clinical activities, surgical procedures, and diagnostic interventions during regular working hours. Similar patterns were reported in studies from France (2013) and the United Kingdom (2008).(3, 7–9)

The Adult Emergency Room was the main source of ICU admissions, followed by the Operating Room and general wards. Comparable findings were reported in a study conducted in Kenya (2019) , where the emergency department was the primary source of ICU transfers. Emergency-based transports have also been associated with higher risks due to patient instability, as reported in a French study (2013)(1,12,25).

Organ System Involvement and Patient Admit

Most patients in this study were admitted to the ICU for single organ dysfunction, mainly respiratory, followed by neurological and cardiovascular conditions. Among those with multiple organ involvement, the most common combination was respiratory and cardiovascular compromise. Similar findings were reported in studies conducted in Brazil (2012) and France (2013), where respiratory and cardiovascular Patients with respiratory or cardiovascular instability are particularly vulnerable during intra-hospital transport due to limited physiological reserve. Studies from France (2013) and the United Kingdom (2008) also reported that cardiovascular and respiratory complications were among the most frequent adverse events, especially in emergency transfers (1,2,5,24).

Personnel Involvement during Transport

Most patient transfers involved four to five personnel, with nurses participating in the majority of cases. Multidisciplinary teams, typically including nurses, physicians, residents, and support staff, help enhance patient safety. Several studies support this finding: in Brazil (2012), multidisciplinary teams reduced complications during intra-hospital transport of critically ill adults ; in Kenya,(2013) adequate staffing and trained personnel were linked to safer transfers (Kenya, 2019) and in France, team composition significantly influenced complication rates .(3, 9,11)

However, some studies report that even with multidisciplinary teams, adverse events still occurred, often due to insufficient training, poor communication, or equipment issues. This suggests that while the presence of an adequate team is essential, the competency, experience, and coordination of staff are critical factors in reducing transport-related complications. The relatively low rate of severe adverse events observed in this study may therefore reflect not only the number of personnel involved but also their experience and the structured approach to patient transfer.(12–14)

Monitoring Modalities and Equipment Availability

The most commonly used monitoring combination during transport was pulse oximetry, respiratory rate, and heart rate, while advanced modalities such as invasive blood pressure monitoring were rarely utilized. International guidelines recommend continuous monitoring of vital parameters, including oxygen saturation, heart rate, and blood pressure during intra-hospital transport (Pakistan 2008). The limited use of advanced monitoring in this study likely reflects resource constraints rather than lack of awareness, a challenge frequently reported in low-resource settings such as Kenya (, 2019) (9,26,28).

Notably, over one-quarter of patients was transported without any monitoring equipment, and oxygen cylinders were available in only 44% of cases. Although oxygen was relatively accessible, the absence of monitoring or resuscitation devices could expose patients to preventable complications. Similar findings were reported in Brazil (2012), where equipment-related incidents—including disconnections and inadequate preparation—were major contributors to adverse events during intra-hospital transport. Conversely, studies from high-

resource settings indicate that continuous monitoring significantly reduces transport-related complications (France 2013) , underscoring the importance of both equipment availability and staff training to ensure patient safety (2, 25).

Airway and Ventilation Status

More than half of the patients were intubated during transport, and approximately one-quarter required manual ventilation. Manual ventilation can be challenging, particularly during prolonged transfers, as it may result in inconsistent tidal volumes or inadequate ventilation. Previous studies have shown that ventilated patients are at higher risk of respiratory complications during transport, especially when portable ventilators fail or manual ventilation is improperly performed (France 2013). However, the relatively low rate of severe respiratory events in this study suggests that airway management was generally maintained effectively. Similar observations were reported in interhospital transport studies in Norway(2019), where careful monitoring minimized respiratory complications despite manual ventilation (10,25).

Lines, Tubes, and Invasive Devices

Most patients had peripheral venous access, and over half had urethral catheters, whereas only a few had central venous or arterial lines. Dislodgement or malfunction of lines and tubes is a recognized complication during intra-hospital transport Brazil (2012) . In this study, the low incidence of line-related problems indicates that invasive devices were generally well managed, which may reflect adequate staff training and careful handling during transfers.(2)

Adverse Events during Transport

Nearly three-quarters of transports occurred without adverse events. Among reported complications, central nervous system and cardiovascular events were most common, whereas multi-system events were relatively rare. The overall adverse event rate in this study appears lower than in many international reports, which range from 22% to 68% in Brazil (2012) and France (2013), and 10.4% to 44% in India (2023). Other research has documented incident rates of 45.8% in Spain (2013) and 23.4% in South Africa (2017).

This discrepancy may be due to differences in event definitions, reporting practices, or improvements in transport preparation. Nevertheless, cardiovascular and neurological complications remain the most frequent, consistent with prior research indicating that these systems are highly sensitive to physiological changes and environmental stress during movement in Kenya (2014) and India (2025).(2, 6, 24,26).

Equipment and Infrastructure Factors

No elevator or electricity failures were reported, and corridors were consistently clear, suggesting minimal infrastructure-related challenges. Equipment failure occurred in a small proportion of cases; although uncommon, even minor malfunctions can have serious consequences for critically ill patients. Previous studies emphasize the importance of pre-transport equipment checks and preparation to reduce risks in Pakistan (2008) and China (2025). The low incidence of equipment-related complications in this study may reflect careful preparation and adherence to guidelines despite limited resources(2,21,27)

Communication and Handover

Communication before transfer occurred in the vast majority of cases, and documentation was completed in almost all transports, with patient identity correctly confirmed in every instance. Effective communication and structured handover are essential for safe intra-hospital transport, as failures in these processes have been linked to increased adverse events in multiple studies from Brazil (2012) and Kenya (2014). The high adherence to communication and documentation protocols in this study likely contributed to the relatively low incidence of transport-related complications, highlighting the importance of standardized handover procedures even in resource-limited settings (3, 10).

6 Conclusion

The study highlights intra-hospital transport of critically ill patients to adult Intensive care units at St. Paul's Hospital millennium medical college and AaBET Hospital. Male patients and those with single organ system dysfunction, particularly respiratory and cardiovascular compromise, were most commonly transported. Transport was usually conducted by multidisciplinary teams, primarily nurses, and most patients were monitored using basic vital sign modalities, with limited use of advanced monitoring. Although a small proportion of patients were transported without equipment, airway, line, and catheter management were largely maintained, contributing to the relatively low rate of severe adverse events.

Cardiovascular(arrhythmia)and neurological complications were the most frequent, consistent with known physiological vulnerabilities during transport. Infrastructure-related challenges were minimal and effective communication and structured handover likely enhanced patient safety. .

Optimize Airway and Physiological Management Critically ill patients requiring intubation or manual ventilation should be monitored closely during transport. Staff should be trained in airway management and the use of portable ventilators to reduce respiratory complications. Special attention should be given to securing lines, tubes, and invasive devices.

Standardize Communication and Handover Structured communication protocols and thorough documentation should be mandatory before every transport. Confirming patient identity and providing standardized handover information can reduce preventable adverse events.

7 Recommendations

For transporting and receiving unit/team-

- ✓ All critically ill patients should be stabilized and reassessed before transfer, including airway, breathing, circulation, and neurological status.
- ✓ At minimum, pulse oximetry, heart rate, and blood pressure monitoring should accompany all patients during transfer.
- ✓ Transport teams should include adequately trained nurses and physicians, especially for unstable or ventilated patients.

For Hospitals

- ✓ Hospitals should ensure adequate supply of portable monitors, oxygen cylinders, suction devices, and emergency medications.
- ✓ Standard operating procedures and checklists should be established and adherence for intra-hospital transport.
- ✓ Regular audits of transport practices and incident reporting systems should be implemented to identify and address safety gaps.

For the Ministry of Health (MOH)

- ✓ Ensure hospitals are equipped with essential monitoring and transport equipment.

For Future Researchers

- ✓ Large-scale, multicenter studies are needed to better understand transport-related risks across different settings.
- ✓ Future research should evaluate how staff experience and training influence patient outcomes during transport.

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9 Annex

QUESTIONNAIRE ON CHALLENGES AND ADVERS EVENTS DURING
IHTRANSPORTS OF CRITICALLY ILL PTIENTS.

SOCIO DEMOGRAPHIC PROFILE

MRN..... GENDER.....AGE.....

DATE OF TRANSFER..... DAY/NIGHT.....

WEAKENED /WEEK DAY DIAGNOSIS.....

1. PATIENT TRANSFER INFORMATION.

REASONS FOR TRANSFER (Tick as appropriate)

Respiratory support .

Cardiovascular support.

Low neurological status .

Metabolic derangement .

Elective post op monitoring Intra-operative event

Postoperatively Delayed awakening

Postoperative event in Post Anesthetic Care unit

Others(specify).....

2. SITE OF ORIGIN (Tick as appropriate)

A. Emergency and critical care department

B). Wards

i). Surgical:

General surgery.....Neurosurgery.....

Cardiothoracic..... Orthopedics.....

Gynecology and Obstetrics..... ENT.....

ii). Medical:

General medical.....Chest.....

Nephrology.....Neurology.....Cardiac

Hematology.....Oncology.....

C). OR

i). Electiv

Cardiothoracic..... Neurosurgery..... Orthopedics General Surgery.....
Gynecology and Obstetrics..... Ear Nose Throat.....

ii). Emergency: Adult emergency Medical..... Trauma Gyny Obs ...

D. Other (specify)

3. TRANSFER DESTINATION

Intensive care unit (ICU)

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

Other (specify).....

6. ACCOMPANYING PERSONNEL

Tick as appropriate the presence of the following accompanying personnel.

i). Nursing staff: YES NO

Indicate their number.....

Qualified nurse: YES NO

Student nurse YES NO

Critical care trained nurse: YES NO

ii) Physician

Indicate their number.....

Consultant (specify).....

Medical Interns.....

Residents R1.....R2.....R3.....

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.

Pulseoximeter

End-tidal Carbon dioxide

Non-invasive blood pressure Invasive blood pressure

Heart rate

Electrocardiogram

Respiratory rate

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 equipment's 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)

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, Head spring 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? YES NO If YES by Nurse,
Physician/ Non-physician.