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St. Paul's Hospital Millennium Medical College

St. Paul Hospital Millennium Medical College Graduate Study Program

**ASSESSMENT OF KNOWLEDGE, ATTITUDE, PRACTICE AND
ASSOCIATED FACTORS TO WARDS FLUID BALANCE
MONITORING AMONG NURSES WORKING IN ADULT ICU OF
ADDIS ABABA BURN EMERGENCY AND TRAUMA HOSPITAL
AND ST.PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE.**

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ADDIS ABABA, ETHIOPIA

OCTOBER 2025



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A THESIS SUBMITTED TO THE DEPARTMENT OF EMERGENCY MEDICINE AND CRITICAL CARE; PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR SPECIALITY TRAINING; ST. PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE.

ADDIS ABABA, ETHIOPIA

NOVEMBER, 2025

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Title of research project	Assessment of knowledge, attitude, practice and associated factors to wards fluid balance monitoring among nurses working in adult ICU of AaBET and SPHMMC
Duration of the project	August 1 to 30/2025
Study area	AaBET and SPHMMC adult ICU
Total cost of the project	24,400 ETB
Source of funding	SPHMMC
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ACKNOWLEDGMENT

First, I would like to express my sincere gratitude to St. Paul's Hospital Millennium Medical College, Department of Emergency Medicine and Critical Care, for granting me the opportunity and financial support to conduct this research.

My deepest appreciation also goes to my advisors, Dr. Rakeb Mulugeta, Assistance professor of ECCM, SPHMMC and Dr. Rediet Solomon Assistance professor of ECCM, SPHMMC for their invaluable guidance, constructive comments, and continuous encouragement throughout the course of this study.

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LIST of ACRONYMS AND ABBREVIATIONS

AA.....Addis Ababa

AaBET..... Addis Ababa burn emergency and trauma

SPHMMC.....St,Paul hospital millennium medical college

ETB.....Ethiopian Birr

BSC Bachelor of Science degree

CNE..... compressive nursing education

EMCC.....Emergency and critical care

EMCCN.....Emergency and critical care nurse

ICU intensive care unit

IFL.....Insensible fluid loss

MD... ..Medical doctor

ml Millilitre

Abstract

Background: Fluid Balance is net result of intake and output of fluid to provide metabolic processes to function correctly. In Intensive care unit the patient needs special consideration for Fluid balance monitoring. Fluid balance monitoring is very vital component in intensive care unit for management and good patient prognosis. Recent studies show negative fluid balance and positive fluid balance adversely affects patient morbidity, mortality and patient length of stay in hospitals.

Even if there is some related researches but still little is known regarding fluid balance monitoring.

Objectives: To assess knowledge, attitude and practice of nurses working in ICU towards fluid balance monitoring and associated factors in SPHMMC and AaBET hospitals, Addis Ababa, Ethiopia .

Methods: institutional based cross-sectional study was conducted from August 1 to 30/2025 in SPHMMC and AaBET hospitals in Addis Ababa. Well-structured questionnaire for socio-Demographic characteristics, knowledge, attitude and practice was adopted from literatures with little modification. The data was analyzed by using Stata version17 Software. Finally the result was computed and interpreted through use of descriptive statistics. Association between variables was analyzed by using logistic regression at p- value <0.2 and <0.05 considering as significant respectively.

Results: Among the participants, more than half of the nurses (52.3%) demonstrated good knowledge, 25.6% had moderate knowledge, and 22.1% had poor knowledge. Attitudes were moderately positive, with a mean unified attitude score of $3.08 (\pm 0.46)$. Self-reported practice was generally high (mean 3.83 ± 0.99), though gaps were noted in monitoring catheterized patients. Knowledge scores and unified attitude scores were significant predictors of practice ($\beta = 0.275$, $p = 0.005$; $\beta = 0.689$, $p = 0.006$, respectively). Male sex was a significant predictor of good knowledge (OR = 5.84; 95% CI: 1.62–21.06; $p = 0.007$). Major barriers to practice included lack of time, inadequate staffing, and unavailability of recording sheets.

Conclusion and recommendation: Despite adequate knowledge and positive attitudes, fluid balance monitoring practices among ICU nurses were inadequate. Increased workload, insufficient training, and limited resources contributed to poor practice. Strengthening continuous training, improving staffing levels, ensuring availability of monitoring tools, and enhancing supportive supervision are essential to improving fluid balance monitoring in ICUs.

Key words: knowledge, practice, fluid balance, monitoring, attitude, input/output.

CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND

Fluid balance monitoring is a key component of patient care within the intensive care unit (ICU). It involves the continuous assessment of a patient's fluid intake and output, which is essential for maintaining normal physiological and metabolic functions (1). The term *monitoring* is derived from the Latin word *monere*, meaning "to warn," highlighting the need for careful observation in clinical practice (2).

Modern intensive care originated in Denmark in 1953, making it a relatively young yet rapidly advancing medical specialty. ICU care provides critically ill patients with advanced support aimed at preventing organ failure and preserving meaningful life. With increasing life expectancy and higher rates of comorbidities, a growing number of patients require intensive care services. According to the Swedish Society of Anesthesia, intensive care focuses on preventing or managing dysfunction in one or more organ systems to ensure that life remains meaningful from the patient's perspective (4).

Fluid balance monitoring entails the systematic assessment, documentation, and calculation of all fluid intake and output. Intake may occur orally or parenterally through food, fluids, or medications, whereas output includes losses through urine, stool, vomiting, perspiration, respiration, and drainage from devices such as nasogastric tubes, chest tubes, and colostomy bags (2,5). Insensible fluid loss can also be estimated using a formula that considers the patient's maximum body temperature and intubation status. Insensible Fluid Loss (mL) = $800 + (20\% \times 800 \times (\text{maximum temperature} - 37))$, with the final value halved for intubated patients.

Typically, adults require 1.5 to 2.5 liters of fluid per day (6), and the minimum acceptable urine output is 0.5 mL/kg/hour. Values below this threshold should be promptly documented and reported to senior staff or the attending physician (6).

Accurate fluid balance monitoring is crucial for guiding clinical decision-making and understanding a patient's overall condition (6, 7). Maintaining adequate hydration is an essential nursing responsibility (8). In contrast, inaccurate or incomplete fluid balance records can contribute to clinical complications and deterioration of the patient's status (9). Recent studies have demonstrated that excessive fluid accumulation in critically ill patients is associated with adverse outcomes, including respiratory failure,

tissue edema, heart failure, hypertension, and peripheral edema. Moreover, sustaining a positive fluid balance for more than four days has been linked to increased mortality (10).

1.2. Statement of the problem

Intensive care nurses bear a large burden in both managing and implementing the interdisciplinary team's plan for fluid balance monitoring and progress towards goals as monitoring is very important component of care provided to a patient in intensive care unit (5).

As many studies indicated most of intensive care unit nurses had inadequate knowledge and practice regarding fluid balance monitoring as they do not have sufficient information specially insensible loss as output and this create a gap during intensive patient monitoring. Literature shows negative fluid balance and positive fluid balance adversely affects patient morbidity, mortality and patient length of stay in hospitals (11).

In Africa, nurses viewed fluid balance monitoring as an important practice towards patient care; though the act of close observation and checking remains problematic due to lack of pre and post-service training, lack of resources and supplies ,lack of comprehensive nursing education lack of time and workload (5).

Improper fluid balance monitoring and record keeping in nurses has been shown to have negative impacts on the health care of patients, the health care providers ,the profession and associated with the problem of under hydration or over hydration become high. Furthermore, not only it is linked with suboptimal health care service provision, the health care provider and the health organizations can also place at considerable risk of legal harm for in appropriate act of fluid balance monitoring ((10,11).

study in south Africa which was conducted at Stellenbosch university fluid balance monitoring practice was poor because of different reasons, like unfavorable attitude of nurses and insufficient knowledge towards fluid balance monitoring, low nurse-to-patient ratio, lack of in-service training , lack of guidelines, shortage of time and workload (2).

The literature and best nursing practice emphasize the requirement of accurate and correct fluid balance monitoring in critically ill patients. The researcher's clinical practice experience, together with the data from the informal audit, identified that fluid balance monitoring was generally not done correctly by nurses working in critical care unit(5).

This study was conducted in the ICUs of SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, where evidence on this subject was previously unavailable. It assessed nurses' knowledge, attitudes, and practices related to fluid balance monitoring and explored the factors affecting these parameters.

Additionally, the study measured overall KAP levels, compared the results with international findings, and proposed practical recommendations to address the identified deficiencies.

1.3. Significance of study

The findings of this study will provide baseline information on the current status of nurse's knowledge; attitude and practice towards fluid balance monitoring and give clue about possible factors that result in poor fluid balance monitoring as well as it will alert ministry of health, hospitals and administrative bodies to give intervention for the problem.

In addition to this, policy makers will get information about the problem and associated factors while designing an intervention that improve fluid balance monitoring among nurses working in intensive care unit and also helps as base line information for further studies.

CHAPTER TWO

LITERATURE REVIEW

Appropriate fluid balance monitoring is needed for diagnosis and management of critically ill patients. According to research done in Australia and New Zealand mortality for positive fluid balance is 57.2% and 32% for negative fluid balance monitoring (12). Inappropriate fluid balance monitoring or recording will make patient condition worse (9) in addition to this, health professionals like physicians, critical care nurses, surgeons and dietitian etc. requires accurate fluid balance documentation for planning of patient's treatment. It is necessary to know the exact measures of input and output for quality treatment. Such information is very necessary to prevent the patients from complications like fluid overload (13). High fluid volume intake, in line with endocrine and renal responses which enables to decreased water and salt excretion, the accumulation of a positive fluid and sodium balance is common. Fluid excess in critically ill patients is consistently associated with adverse outcomes. This has been demonstrated both in adults and children with sepsis, ARDS (14), and acute kidney damage (10) the study noted that fluid balance monitoring improves the practices of accurate fluid balance documentations(9) .In order to prevent complication and ensure that ICU patients receive high-quality care, nurses understanding of fluid and electrolyte management is essential(15).

2.1. Nurses knowledge towards fluid balance monitoring

Study in Pakistan showed that on average 46.67% of study participants had got knowledge about the fluid balance monitoring where to record, who is responsible for correct fluid balance calculation and measurement (7).

Study in Egypt Alexandria university witnessed that 61.67% of study participants had got moderate knowledge regarding to fluid balance monitoring and Nurses knowledge towards fluids or drugs infused continuously accounts 91.67% , clinical signs associated with hypovolemia/ hypervolemia accounts 66.67% and which vital signs are a part of fluid balance assessment of patient accounts 60% . In spite of this nurses knowledge regarding other items of fluid balance monitoring is poor especially; average amount of urine output accounts 58.33%, factors affecting urine output accounts 41.67% , nurses action for patients who has hypovolemia /hypervolemia accounts 41.67%) and the required amount of fluid intake an adult patient per day (15). And also a study in Egypt Assist University witnessed that nurses' knowledge related to the physiology of fluid therapy and creep shows a substantial improvement after the application of the training (p value .001)(16).

In Ethiopia, studies similarly demonstrate significant knowledge gaps among nurses. Study from Central Ethiopia reported that 57.6% of nurses had good knowledge of IV fluid administration, but major deficits existed

in areas like fluid calculation for pediatric patients (33). Another study in Hawassa found that only 44.6% of nurses had good knowledge regarding nursing documentation, including fluid recording components (34). Similarly, research in West Gojjam Zone Amhara region assessed nurses' knowledge, attitude, and practice towards nursing care documentation shows only 54.6% had good knowledge (35).

2.2. Nurses attitude towards fluid balance monitoring

Nurses' attitudes toward fluid balance monitoring play a vital role in ensuring accurate assessment, timely intervention, and improved patient outcomes, particularly in critically ill patients. Several studies conducted in different settings have demonstrated that a positive attitude is a key determinant of good monitoring practices. Evidence from Egypt, particularly at *Alexandria University*, revealed that most nurses perceived fluid balance monitoring as an essential component of high-quality patient care. The study showed that 79.2% of nurses had a positive attitude toward fluid balance monitoring, recognizing its value in improving both the quality and performance of patient care services (17). This finding highlights a general awareness among nurses about the importance of proper fluid management in sustaining physiological stability.

Similarly, research from Assiut University, Egypt, emphasized the influence of educational interventions on nurses' perceptions. Following scenario-based teaching, nurses demonstrated significantly improved attitudes toward fluid balance monitoring. Importantly, all participants agreed that inaccurate fluid balance calculations pose serious risks to critically ill patients. The study also highlighted that nurses acknowledged the harmful effects of positive fluid balance, which can be as detrimental as negative balance, especially in patients with cardiorespiratory compromise (16). This underscores the need for ongoing training and reinforcement of fluid m
In the Ethiopian context; studies assessing nurses' attitudes toward documentation and monitoring practices reveal both positive perceptions and areas for improvement. Evidence from Amhara region West Gojjam Zone showed that a majority of nurses agreed that proper documentation including fluid balance charts is essential for communication with other healthcare providers and continuity of care (35).

2.3. Nurses practice towards fluid balance monitoring

The study done in Nether land shows that there is (5.1%) of calculation errors in fluid balance monitoring practice(18) study done south Africa Stellenbosch university showed that Forty-nine cases (33%) of incorrect calculation (19).

A study done in Pakistan shows a poor practice of nurses in ICU on average 45.47% towards fluid balance monitoring like timely input and output measurement (47%), fluid balance documentation filled by more than one person (52%), timely calculation of daily fluid balance (43%), Inaccurate fluid balance calculation (39.9%) and assessing practice through observation on average is 71.14% (7).

In the study done in Iran (48.7%) of patients fluid balance status was not monitored,(26.5%) of patients encounter fluid balance calculation error, (29.8%) of patients rate of fluid administering have an error (20), and also study done in south Africa indicate that among patients who are taking diuretic therapy there is significant fluid balance monitoring practice problem (68.9 % , 13.5%, 6.9% ,5.8%) with the following ml deviations respectively(500ml, 500ml-1000ml,1000-2000ml, greater than 2000ml) over 24 hour (5).

Studies conducted across various regions of Ethiopia consistently show that nurses' documentation and fluid monitoring practices remain inadequate despite generally favorable attitudes. Evidence from West Gojjam indicates that nurses demonstrate poor to moderate documentation performance, with frequent delays in recording, incomplete notes, and inaccurate fluid charts; these challenges were largely attributed to system-related issues such as lack of in-service training, absence of standard documentation sheets, high patient-to-nurse ratios, and limited supervision (35) . Similar problems are reflected in Hawassa, where a study of 413 nurses found a marked gap between attitude and practice, although more than half had a favorable attitude toward documentation, many failed to record interventions, patient condition changes, or complete fluid intake/output charts (34). In Tigray, only about half of nurses documented care according to expected standards, with staffing shortages, unfamiliarity with operational guidelines, time constraints, and low confidence in fluid-balance calculations contributing to incomplete or inaccurate recordings(36). Evidence from Central Ethiopia further supports this pattern, showing that while 57.6% of nurses had good knowledge of IV fluid administration, their practice was substantially lower, particularly in calculating pediatric fluid needs, monitoring urine output, and documenting total fluid balance. Collectively, these findings across multiple regions demonstrate a consistent knowledge–practice gap, largely driven by systemic constraints and insufficient practical training rather than lack of awareness or attitude, underscoring the need for improved resources, skill-based training, and supportive supervision to strengthen nurses' documentation practice nationwide (33).

2.4. Associated factors that affect fluid balance monitoring in ICU

Studies conducted in different countries have identified multiple factors influencing nurses' practice of fluid balance monitoring. In Egypt, research shows that nurses' knowledge and skills are significant determinants of accurate fluid monitoring. Lack of training, limited experience in scenario-based patient care, and insufficient understanding of the clinical consequences of inaccurate fluid balance were reported as major barriers to effective practice (15). Similarly in Ethiopia West Gojjam, nurses' documentation and fluid monitoring practices were affected by systemic and organizational factors, including the absence of standard documentation sheets, high patient-to-nurse ratios, limited supervision, and inadequate in-service training (35).

Evidence from Hawassa revealed that nurses' level of knowledge, availability of standard documentation tools, and department of assignment (outpatient versus inpatient) significantly influenced fluid balance monitoring. Nurses with higher knowledge levels and access to proper tools demonstrated better practice, while those in high-workload units performed poorly (34). In Tigray, practice was hindered by staff shortages, unfamiliarity with operational documentation guidelines, time constraints, and low confidence in performing fluid-balance calculations (36). Similarly, Central Ethiopia studies showed that despite moderate to good knowledge, nurses' actual practice in monitoring fluids especially in pediatric patients was inadequate due to limited skill-based training and lack of standardization (33).

2.4.1. Socio-demographic characteristics

Studies examining the demographic characteristics of ICU nurses across different countries show consistent patterns in age, gender, education, and experience. A study conducted in Pakistan reported that the majority of nurses were aged 26–30 years (39.42%) and 31–35 years (38.46%), while smaller proportions were in the 20–25 years (14.9%) and 36–40 years (7.21%) age groups. More than half of the participants (53.85%) were married, and all were female. Regarding educational qualifications, most nurses held a General Nursing Diploma (77.4%), followed by Post-RN BSN (12.02%), specialization (10.10%), and MSN (0.48%). ICU work experience ranged

from less than 1 year (18.27%) to 5–10 years (37.02%), with a smaller proportion having more than 10 years (8.17%) (7). Similarly, a study in Egypt showed that over half of nurses (51.7%) were aged 25–30 years, with the majority being female (83.3%). Most nurses (53.3%) had technical institute qualifications, 58.3% had 5–10 years of professional experience, and more than three-quarters (76.7%) were married. Notably, 85% of the participants had not attended any previous training programs(15).

Ethiopian studies reveal a comparable demographic profile among ICU nurses. In West Gojjam, most nurses were female, predominantly aged 26–35 years, and had diploma-level education, with varying years of professional experience (35). Research from Central Ethiopia indicated that nurses aged 25–35 years comprised the majority, with diploma qualifications being most common and ICU experience ranging from less than 1 year to over 10 years(33). In Hawassa, the largest group of nurses was aged 26–30 years, with more than half was having 1–10 years of ICU experience, and most holding diploma-level qualifications (34). Evidence from Tigray showed that about half of the nurses were aged 25–35 years, primarily female, and largely diploma or post-RN BSN holders, with clinical experience mostly less than 10 years (36). Collectively, these findings suggest that ICU nurses in Ethiopia share a mid-career age profile, are predominantly female, and hold diploma-level education, similar to patterns observed in Pakistan and Egypt—providing important context for understanding their knowledge, attitudes, and practices in critical care settings.

2.4.2. Organizational factors

Organizational factors play a critical role in influencing nurses' ability to accurately monitor fluid balance in clinical settings. Studies across multiple regions have identified several key barriers. In West Gojjam, inadequate availability of standard documentation sheets, high patient-to-nurse ratios, and limited supervisory support were major organizational constraints that hindered accurate and timely recording of fluid intake and output (35). Similarly, the Hawassa study found that the presence of standard documentation tools, effective supervision, and structured work environments significantly improved nurses' monitoring practices, whereas lack of these resources led to incomplete or inconsistent documentation (34). In Tigray, staff shortages, heavy workload, and insufficient familiarity with operational documentation guidelines were reported as primary organizational

challenges, contributing to poor recording and low confidence in fluid balance calculations (36). Central Ethiopia studies also highlighted that the absence of standardized forms, inadequate training programs, and limited administrative support negatively affected nurses' ability to perform precise fluid monitoring, especially in high-risk areas such as pediatrics and intensive care (33).

2.5. Conceptual Framework

After reviewing different literatures the following conceptual frame work is adopted.

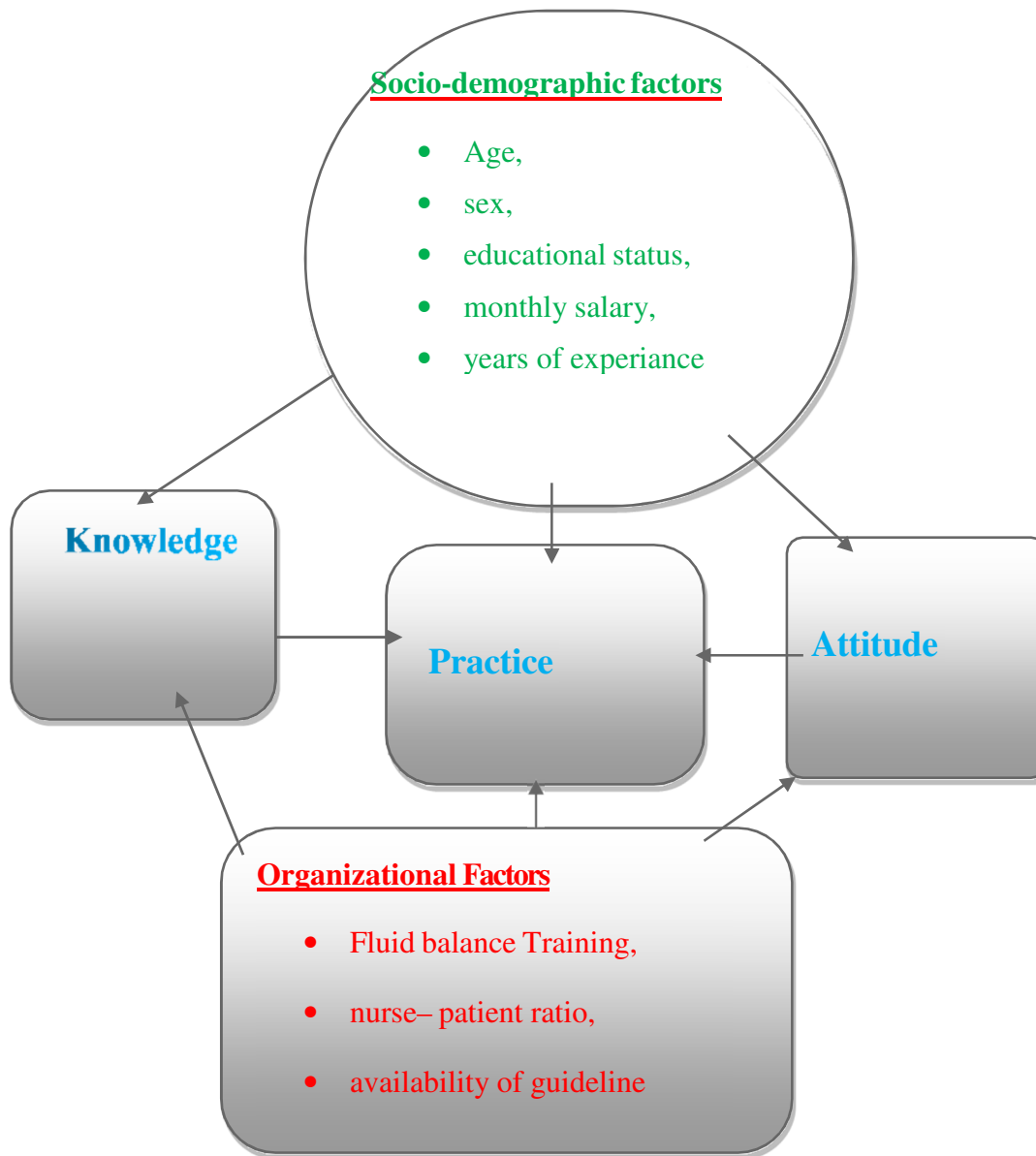


Figure 1: Conceptual framework on fluid balance monitoring

CHAPTER THREE

OBJECTIVES

3.1. General Objective

- ❖ To assess knowledge, attitude, practice and associated factors towards fluid balance monitoring among nurses working in adult ICU of AaBET and SPHMMC Addis Ababa, Ethiopia, August 1 to 30 / 2025GC.

3.2. Specific Objectives

- ❖ To evaluate knowledge towards fluid balance monitoring among nurses working in adult ICU of AaBET and SPHMMC Addis Ababa, Ethiopia, August 1 to 30 / 2025GC.
- ❖ To analyze attitude towards fluid balance monitoring among nurses working in adult ICU of AaBET and SPHMMC Addis Ababa, Ethiopia, August 1 to 30 / 2025GC.
- ❖ To examine the practice of nurses in fluid balance monitoring working in adult ICU of AaBET and SPHMMC Addis Ababa, Ethiopia, August 1 to 30 / 2025GC.
- ❖ To identify factors affecting knowledge, attitude and practice of nurses on fluid balance monitoring working in adult ICU of AaBET and SPHMMC Addis Ababa, Ethiopia, August 1 to 30 / 2025GC ICU.

CHAPTER FOUR

4. METHODS AND MATERIALS

4.1. Study Area

This study was carried out in the ICU departments of two hospitals in Addis Ababa, Ethiopia. Addis Ababa, the capital and largest city of the country, covers an estimated area of 530 km² and lies at an altitude ranging from 2,200 to 3,000 meters above sea level. The city experiences an average temperature of 22.8°C and an annual rainfall of approximately 1,180.4 mm. It hosts more than 124 health facilities, including 15 government hospitals. Among these, St. Paul's Hospital Millennium Medical College and Addis Ababa Burn, Emergency, and Trauma Hospital were selected as study sites.

4.1.1. St. Paul's Hospital Millennium Medical College

St. Paul's Hospital Millennium Medical College, founded in 1968 during the reign of Emperor Haile Selassie, is one of Ethiopia's leading teaching and referral hospitals. Located in Addis Ababa, it provides a wide range of postgraduate and subspecialty training programs and employs more than 2,800 staff across clinical, academic, and administrative roles. The hospital has a capacity of over 700 beds, serving a large inpatient population and delivering care to more than 1,200 outpatient and emergency clients daily.

The hospital operates a fully functional ICU with 13 beds, each supported by a dedicated nurse to ensure one-to-one patient care. The unit is further strengthened by a multidisciplinary medical team comprising an intensivist, fellows, and a resident physician who are available daily to provide comprehensive critical care services.

4.1.2. Addis Ababa Burn and Emergency Trauma (AaBET) Hospital

Addis Ababa Burn and Emergency Trauma (AaBET) Hospital, affiliated with St. Paul's Hospital Millennium Medical College (SPHMMC), was established in August 2015 by the Federal Ministry of Health (FMoH). The hospital was founded with the mission of delivering round-the-clock burn care, emergency services, and trauma management. It consists of four main departments: Emergency Medicine and Critical Care, Plastic, Reconstructive and Hand Surgery, Orthopedics and

Traumatology, and Neurosurgery. AaBET Hospital also operates an ICU to provide specialized care for critically ill patients.

4.2. Study period:

The study was conducted from August 1 to 30/2025 GC.

4.3. Study design:

Institutional based cross-sectional study design was conducted on adult intensive care nurses working on SPHMMC and AaBET hospitals by using self-administered questionnaires.

4.4. Source & Study population

4.4.1. Source population

All nurses working in ICUs of all hospitals in Addis Ababa during the study period.

4.4.2. Study Population

All nurses working in adult ICU of SPHMMC and AaBET hospitals during study period.

4.5. Eligibility criteria

4.5.1. Inclusion criteria

The study included all nurses working in the adult ICUs of SPHMMC and AaBET hospitals who were willing to participate.

4.5.2. Exclusion criteria

Those nurses on annual leave and sick leave during data collection.

4.6. Sample size determination and procedure

Sample size calculation

$n = Z^2 p (1-p) / d^2$, n sample size, Z=1.96 at 95% confidence level, P=proportion level (magnitude),
d =margin of error

Hence, $n = (1.96)^2 p (1-p)/d^2$

Taking p=50%, d=5%, n=384 (where p=50%, since there no previous study

$n = [(1.96)^2 (0.5 * 0.5)] / (0.05 * 0.05) = 384$

Then corrected sample size = $n / (1 + (n-1)/N) = 384 / (1 + (384-1)/96) = 77$

Finally 10% non-respondent added = $77 + (77 * 0.1) = 85$

4.6.1. Sampling technique/procedure

The research was conducted in all nurses, working in adult ICU of AaBET and SPHMMC who fulfills inclusion criteria in the study areas and period.

A simple random sampling technique was used to select study participants.

Table1: Nurses who are working at AaBET and SPHMMC hospitals.

S.NO	Name of hospitals	Number of ICU nurses
1	St.Paul hospitam millennium medical college	49
2	Addis Ababa Burn, Emergency and Trauma	47
3	Total	95

4.7. Study Variables

4.7.1. Dependent Variable

- Knowledge
- Attitude
- Practice

4.7.2. Independent Variables

Socio-demographic and Organizational Factors

- Age
- Sex
- Educational status
- Years of experience
- Monthly salary
- Training
- Workload
- Monitoring tool

4.8. Operational definition

Attitude of fluid balance monitoring; indicate that belief of nurses towards intake and output of fluid on critically ill patients.

Good knowledge: Nurses working in the ICU who demonstrate adequate knowledge, defined as scoring 75% or above on the knowledge questionnaire related to fluid balance monitoring (37).

Moderate Knowledge: Nurses working in the ICU who achieve a knowledge score between 60% and 74% on the fluid balance monitoring questionnaire (37).

Poor knowledge: Nurses working in the ICU who score below 60% on the fluid balance monitoring knowledge questionnaire(37)

Favorable attitude: - nurses working in ICU who scores more than 60% of Likert scale questionnaires toward fluid balance monitoring(37)

Unfavorable attitude: - nurses working in ICU who scores less than 60% of Likert scale questioners toward fluid balance monitoring(37)

Fluid balance monitoring: - measuring input, output and net consciously for critically ill patients in ICU(1)

Good practice: - nurses working in ICU who scores more than mean score of Likert scale questionnaires toward fluid balance monitoring(37)

Poor practice: - nurses working in ICU who scores less than mean score of Likert scale questioners toward fluid balance monitoring.(37)

Workload: nurse to patient ratio of 1to2 or more for those nurses working in ICU(38)

4.9. Data collection tools and procedure

The study tools are adopted from different literatures (2, 5,17) with little modification to assess KAP of nurses towards fluid balance monitoring in ICU. These tools have five parts such as socio-demographic characteristic, Knowledge, Attitude, practice and associated factors toward fluid balance monitoring using well-structured questionnaires through self-administered response method.

For data collection three BSC nurses with clinical experience of one year and above were selected by researcher and training was given by principal investigator on how to collect the intended data for this study.

4.10. Data quality assurance

To assure quality of the data the following measures was taken; Two weeks prior to the actual data Collection, questionnaires were pre tested for necessary modifications in the questionnaire. For data collectors, one day short training was given to enhance the quality of data and to ensure that all the data collectors to have the same information about the study tools, to follow the same survey procedures.

4.11. Data processing and Statistical Analysis

Data Analysis was done using SPSS with personal computer. Output drafts were checked against the revised coded data for typing and spelling mistakes. Finally, analysis and interpretation of data was done. Descriptive statistics including frequency distribution, percentage, mean, and standard deviation were used to describe different characteristics. Pearson correlation coefficient, Bivariate and multivariate logistic regressions were used. Researcher consider a significance level when p-value less than 0.2 and 0.05 in binary and multiple logistic regression respectively.

4.12. Ethical considerations

An official letter clarifying the purpose and setting of the study was obtained from the department of emergency medicine and critical care at SPHMMC to conduct the study. Each nurse was informed about the significance and aim of the study and then an informed written consent was obtained from each nurse before participating in the study.

4.13. Dissemination of result

The study result will be presented to SPHMMC, Department of emergency medicine and critical care, and federal Ministry of health.

Furthermore the manuscript will be submitted to national and international peer review journals for possible publicationn.

CHAPTER FIVE

5. RESULTS AND DISCUSSION

5.1. RESULTS

5.1.1. Socio-Demographic Characteristics of Respondents

A total of eighty-six (86) healthcare professionals were participated in this study. The socio-demographic characteristics of the respondents are summarized in Table 1. The sample comprised an equal distribution of males and females (50.0% each, n=43). The majority of respondents (84.9%, n=73) held a first degree as their highest educational qualification, followed by those with a Master's degree and above (14.0%, n=12), and one respondent (1.2%) held a diploma.

The age of respondents ranged from 20 to 41 years, with a mean age of 29.0 years (± 3.8). More than half of the respondents (52.3%, n=45) were within the 25-29 years age. The years of professional experience ranged from 0 to 15 years, with a mean of 5.8 years (± 2.7). A significant majority of the respondents (75.6%, n=65) had four or more years of experience. Cross-tabulation revealed no statistically significant association between the level of education and years of experience ($\chi^2 = 1.79$, $p = 0.409$).

Table 2: Socio-Demographic Characteristics of Respondents

Characteristic	Category	Frequency	Percentage (%)
Sex	Female	43	50.0
	Male	43	50.0
Highest Educational Level	Degree	73	84.9
	Diploma	1	1.2
	MSc and Above	12	14.0
Age Group (Years)	< 25	10	11.6
	25 – 29	45	52.3
	30 – 34	27	31.4
	35+	4	4.7
Experience Group (Years)	< 4 years	13	15.1
	4 – 10 years	65	75.6
	10+ years	8	9.3

5.1.2. Knowledge of Fluid Balance Monitoring

Knowledge: The overall knowledge status was categorized into three levels, revealing that slightly over half of the nurses (52.3%, n=45) had 'Good' knowledge, while about one-quarter (25.6%, n=22) had 'Moderate' knowledge, and the remainder (22.1%, n=19) had 'Poor' knowledge (Figure 1).

Table 3: Knowledge assessment of the study participants

Knowledge Question Items	Correct, n (%)	Incorrect n (%)
Expected urine output in an average adult person	86 (100.0)	0 (0.0)
On average an adult patient requires fluid intake (excluding solids) per day	86 (100.0)	0 (0.0)
What percentage of incorrect fluid balance calculation do you consider acceptable?	15 (17.4)	71 (82.6)
Clinical signs that most likely occur in a patient who is hypervolemic	86 (100.0)	0 (0.0)
Blood products are included in the fluid balance	75 (87.2)	11 (12.8)
Do you measure fluids that are given with drugs?	84 (97.7)	2 (2.3)
Among three vital signs, which one is usually used as part of fluid balance assessment?	86 (100.0)	0 (0.0)
First intervention for a patient who has not passed any urine in the catheter bag for the past hour	86 (100.0)	0 (0.0)
Fluid balance assessment does not include the following data	30 (34.9)	56 (65.1)

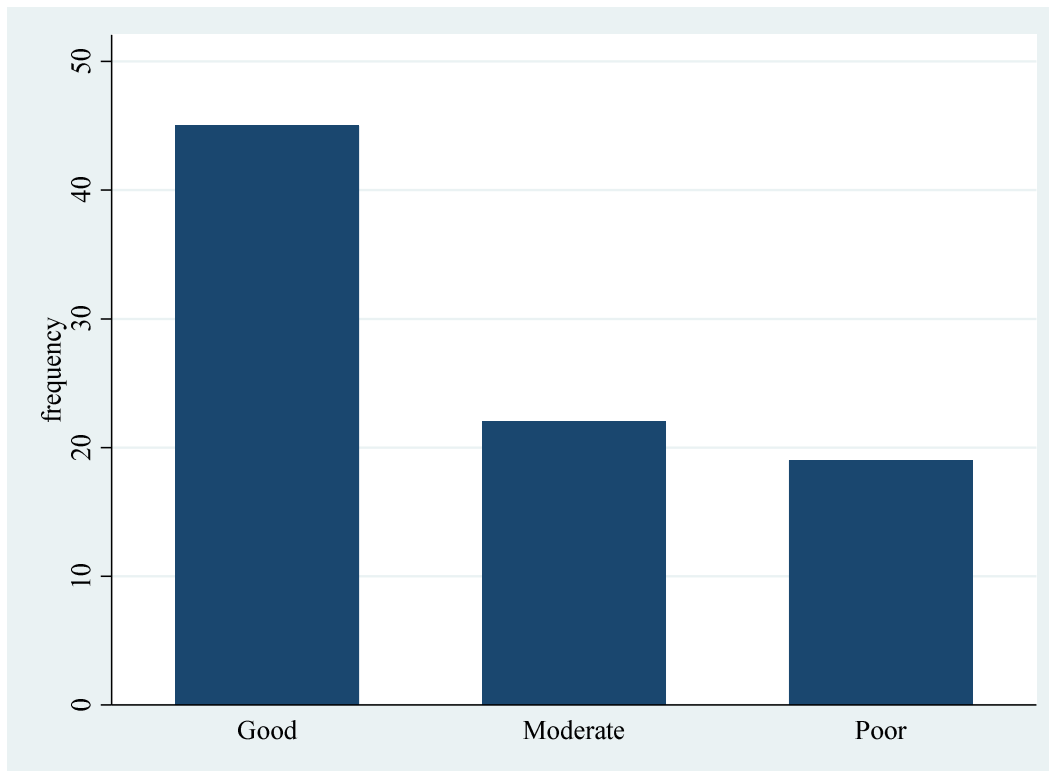


Figure 2: Categorization of Nurses' Knowledge Levels on Fluid Balance Monitoring

5.1.3. Attitudes To wards Fluid Balance Monitoring

Respondents' attitudes were analyzed using composite scores. The mean score for positive attitudes (encompassing satisfaction, perceived adequacy of chart space, and perceived importance) was 3.36 (± 0.80) on a 5-point Likert scale. The mean score for negative attitudes (encompassing perceptions of complexity and burden) was 3.39 (± 0.77). The unified attitude score, which integrated all attitude dimensions, had a mean of 3.08 (± 0.46).

Table 4: Attitude of ICU Nurses towards Fluid Balance Monitoring

Attitude of study participants	Agree, n(%)	Neutral, n(%)	Disagree, n(%)
Fluid balance monitoring is an important nursing activity	70(81.4)	12(14.0)	4(4.7)
There are too many people who fill in one patient's fluid balance chart	50(58.1)	20(23.3)	16(18.7)
As ICU staff I am responsible for more than one patient's fluid balance	60(69.7)	16(18.6)	10(11.6)
I am satisfied with the design of the fluid chart sheet	60(69.8)	15(17.4)	11(12.7)
The space to write fluid numbers on the chart is adequate	60(69.8)	14(16.3)	12(13.9)
The final 24-hour fluid balance is not correctly calculated all the time	40(46.6)	25(29.1)	21(24.4)
Fluid balance assessment is important to guide ICU nursing care	72(83.7)	10(11.6)	4(4.7)
Inaccurate fluid balance calculation can be a risk to patients	68(79.1)	12(14.0)	6(7.0)
Fluid balance information is recorded in too many different places	30(34.9)	30(34.9)	26(30.3)

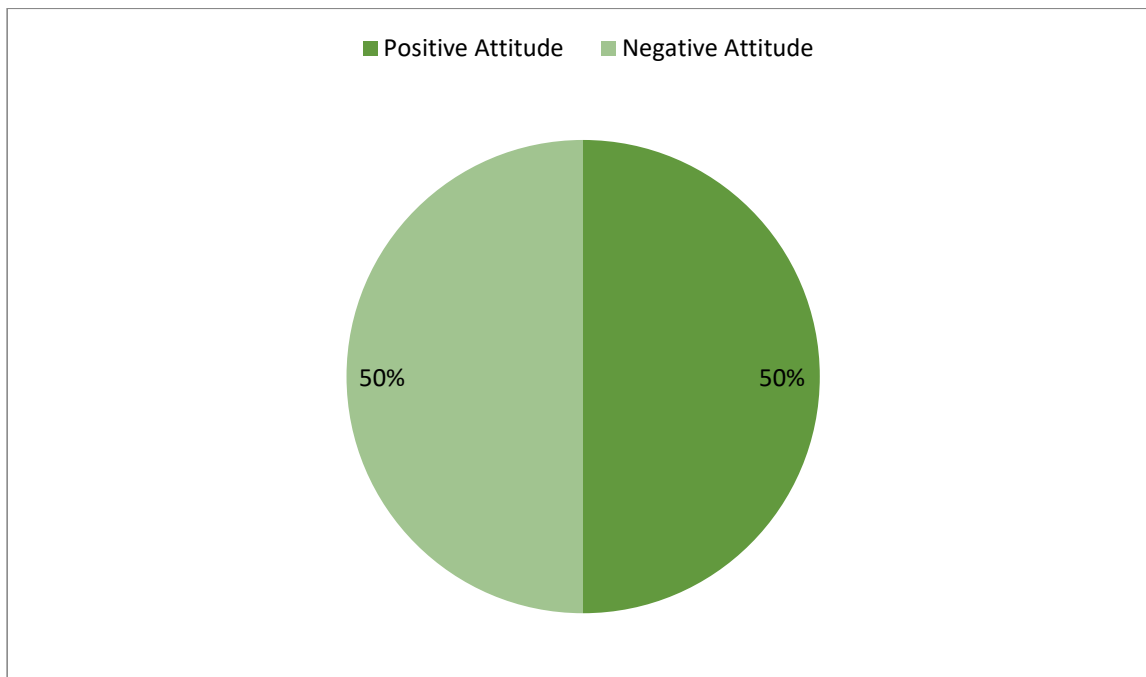


Figure 3 Attitude score of ICU nurses toward fluid balance monitoring

Self-Reported Practices on Fluid Balance Monitoring

The self-reported practice of fluid balance monitoring was generally high. The mean practice score was 3.83 (± 0.99) on a 5-point scale. Analysis of individual practice items revealed that half of the respondents (50.0%, $n=43$) reported *always* accurately measuring intravenous medications as fluid input. A similar proportion (40.5%, $n=34$) reported *always* accurately measuring outputs from drains, vomit, and stool. However, only 36.0% ($n=31$) reported *always* monitoring and documenting intake and output for catheterized patients.

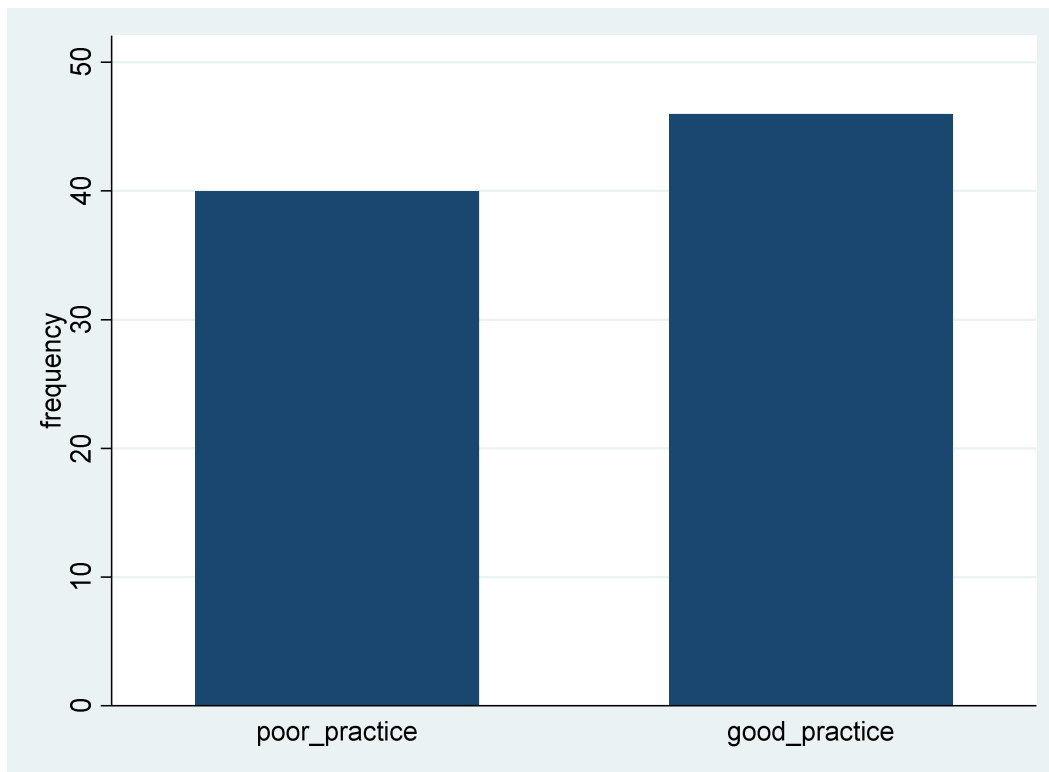


Figure 4: Practice levels of ICU nurses

5.2. Training, Recording Practices, and Identified Barriers

The vast majority of respondents (78%, n=67) reported that they had not received formal training on fluid balance monitoring. Despite this, most respondents (75.6%, n=65) reported that they do record fluid balance monitoring for their patients.

Among the respondents who reported not recording fluid balance (n=20), multiple barriers were identified. As presented in Table 4, the most frequently cited reasons were lack of time (30.0%, n=6) and inadequate staffing (25.0%, n=5). The third most common barrier was the inability to find adequate recording sheets (20.0%, n=4). Other notable barriers included unfamiliarity with nursing standards (15.0%), lack of skill (10.0%). These findings highlight that the primary obstacles are largely related to systemic and resource issues rather than a simple lack of individual knowledge or willingness.

Table 5: Reasons Cited for Not Recording Fluid Balance (n=20)

Reason	Frequency	Percentage (%)
Lack of time	6	30.0
Inadequate staffing	5	25.0
Could not find adequate recording sheet	4	20.0
Unfamiliarity with standard of nursing practice	3	15.0
Lack of skill	2	10

5.3. Relationships between Knowledge, Attitudes, and Practices

Pearson correlation analysis was conducted to examine the relationships between key study variables. A statistically significant positive correlation of moderate strength was found between knowledge scores and practice scores ($r = 0.28$). A stronger, statistically significant positive correlation was found between the unified attitude score and practice scores ($r = 0.36$). However, there was no significant correlation between knowledge scores and overall attitudes ($r = 0.04$). These results suggest that better practices are associated with both higher knowledge and more positive attitudes, but knowledge and attitudes are independent of each other.

Table 6: Correlation between Knowledge, Attitude, and Practice Scores

Variable	Knowledge Score	Practice Score	Unified Attitude Score
1. Knowledge Score	1		
2. Practice Score	0.28*	1	
3. Unified Attitude Score	0.04	0.36*	1

5.3.1. Predictors of Good Knowledge

A logistic regression was performed to ascertain the effects of education, experience, sex, and age on the likelihood of having "Good" knowledge. The model was not statistically significant ($\chi^2 = 8.75$, $p = 0.068$). It explained 10.2% of the variance in knowledge category and correctly classified 77.8% of cases. Of all the predictors, only male sex was a statistically significant predictor, with males having 5.84 times higher odds (95% CI [1.62, 21.06]) of having good knowledge compared to females ($p = 0.007$).

5.3.2. Analysis of Factors Associated with Practice

A multiple linear regression was conducted to identify factors associated with self-reported practice scores in fluid balance monitoring. The model included training status, sex, age group, years of experience, knowledge score, and unified attitude score as independent variables.

The overall regression model was statistically significant ($F(6, 72) = 3.81$, $p = 0.002$) and explained 24.1% of the variance in practice scores ($R^2 = 0.241$).

Analysis of the individual predictors revealed that two factors were statistically significant:

- **Knowledge Score** ($\beta = 0.275$, $p = 0.005$): For every one-unit increase in knowledge score, the practice score increased by 0.275 units, holding all other factors constant.
- **Unified Attitude Score** ($\beta = 0.689$, $p = 0.006$): For every one-unit increase in the unified attitude score, the practice score increased by 0.689 units, holding all other factors constant. This was the strongest predictor in the model.

The following factors were not statistically significant predictors of practice scores: having received formal training on fluid balance ($p = 0.976$), sex ($p = 0.078$), age group ($p = 0.961$), and years of professional experience ($p = 0.678$). Although being male showed a negative association with practice scores that approached statistical significance, it did not reach the conventional threshold of $p < 0.05$.

Table 7: Factors Associated with Self-Reported Practice Scores: A Multiple Linear Regression Analysis

Variable	Category	β Coefficient	Std. Error	t- value	p- value	95% Confidence Interval
Constant		0.951	0.931	1.02	0.310	[-0.905, 2.807]
Received Training	Yes	-0.009	0.312	-0.03	0.976	[-0.632, 0.613]
Sex	Male	-0.417	0.233	-1.79	0.078	[-0.882, 0.048]
Age Group		-0.010	0.213	-0.05	0.961	[-0.434, 0.414]
Years of Experience		0.021	0.051	0.42	0.678	[-0.080, 0.123]
Knowledge Score		0.275	0.095	2.88	0.005	[0.085, 0.464]
Unified Attitude Score		0.689	0.244	2.82	0.006	[0.203, 1.175]

5.4. Discussion

This study aimed to assess the knowledge, attitudes, and practices (KAP) of healthcare professionals regarding fluid balance monitoring in the ICU. The findings reveal a complex interplay between knowledge, attitudes, and contextual factors, highlighting both strengths and critical areas for improvement in the management of critically ill patients, for whom appropriate fluid balance monitoring is essential for diagnosis and management (14).

5.4.1. Knowledge Levels and Their Predictors

The study found a high level of knowledge in fundamental areas, with the majority (77.9%) of healthcare professionals demonstrating "Good" overall knowledge. This finding is notably more positive than a study in Pakistan, which reported that only 46.67% of participants had adequate knowledge regarding recording responsibilities and calculations (7). Our results also surpass those from Alexandria University, Egypt, where 61.67% of nurses had moderate knowledge (15). The high proficiency in core principles identified in our study is encouraging and may reflect a strong foundational training program or clinical exposure.

However, significant gaps were identified in specific domains, particularly in knowing the acceptable percentage of calculation error (17.4% correct) and identifying data excluded from fluid balance (34.9% correct). This indicates that while basic principles are well-understood, more nuanced clinical judgment and protocol-specific knowledge require reinforcement. This aligns with the Alexandria University study, which also found poor knowledge in specific areas like factors affecting urine output (41.67%) (15). Crucially, this pattern is replicated in the Ethiopian context. A study on IV fluid administration in Central Ethiopia found that while 57.6% of nurses had good knowledge, significant gaps remained in specific areas like fluid calculation for pediatric patients (33). Similarly, a study in Hawassa on general nursing documentation found that only 44.6% of nurses had good knowledge (34). The consistency of this finding of good foundational knowledge with critical procedural gaps across multiple Ethiopian studies points to a systemic issue in nursing education and continuous professional

development, where basic principles are taught, but the application of advanced clinical judgment and specific, protocol-driven knowledge is not consistently reinforced.

A striking finding was that formal training did not significantly predict knowledge scores. This is a critical point for institutional policy and contrasts with a study from Assist University, Egypt, which found that nurses' knowledge showed substantial improvement after targeted training (28). This discrepancy suggests that the quality, specificity, or mandatory nature of existing training programs in our setting may need evaluation, as simply providing training is insufficient to ensure comprehensive competency.

5.4.2. The Central Role of Attitudes and Practices

The attitude analysis revealed that the vast majority of respondents recognized the importance of fluid balance monitoring for guiding care and understood the risks of inaccuracy. This positive perception is consistent with a study from Alexandria University, where 79.2% of nurses had positive attitudes (15). Our analysis found that “Perceived Complexity and Burden” was an important issue, as many participants said several people complete the chart and that 24-hour balances are often calculated incorrectly. Similar findings were reported in Pakistan and Egypt, where organizational issues such as workload and shared documentation responsibilities were key barriers (7, 15).

The practice scores were generally high, with strong self-reported adherence to critical tasks like reporting abnormalities and adjusting IV fluids. However, a notable gap was observed in the consistent monitoring of catheterized patients, which had the lowest adherence. This finding is crucial, as inaccurate monitoring can lead to fluid overload, which is consistently associated with adverse outcomes in critically ill patients (32). Our results show a better practice level than studies from Iran and South Africa, which reported high rates of unmonitored patients (48.7%) and significant calculation errors (26.5%) (5, 20).

Most significantly, the regression analysis confirmed that attitude was a stronger driver of practice than knowledge. This aligns with the finding from Egypt that reported a statistically significant association between nurses' perception and knowledge ($p=0.0012$) (15). This underscores that improving practice requires more than just education; it necessitates addressing perceptions and creating a positive culture around the desired behavior.

5.4.3. The Overwhelming Impact of Systemic Barriers

The most compelling findings relate to the barriers to practice. The top barriers lack of time (30%), inadequate staffing (25%), and unavailability of adequate recording sheets (20%) are not individual failures but systemic issues. These results strongly support the findings from Egypt, where ineffective time management and workload were perceived as the most significant factors (100% and 91.67% respectively) affecting fluid balance monitoring (7). Within Ethiopia, the evidence is even more striking. The barriers we identified are almost identical to those reported in Hawassa and West Gojjam (34, 35).

The powerful influence of these systemic barriers is a common theme in global nursing literature, echoing research on "missed nursing care," where documentation is often sacrificed in favor of direct patient care tasks during periods of high workload (28). In the context of our study and the broader Ethiopian landscape, these barriers represent the critical bottleneck that stifles the potential of a knowledgeable and willing nursing workforce.

5.5. Implications for Practice and Policy

The results of this study lead to several concrete recommendations:

- ✓ **Redesign and upgrade training programs:** Move beyond one-off lectures to include hands-on, competency-based training that is regularly reinforced. The content should specifically address areas of knowledge gap and focus on the "why" behind the practice to improve attitudes.
- ✓ **Address Systemic Barriers:** Hospital administration must act on the identified barriers. This includes:
 - **Workload Management:** Reviewing nurse-to-patient ratios and workflows to create protected time for accurate documentation.
 - **Resource Provision:** Ensuring that standardized, user-friendly fluid balance charts are readily available at every bedside.
 - **Clarifying Protocols:** Clearly communicating and easily accessible standard operating procedures for fluid balance monitoring.
- ✓ **Encourage a culture that supports good clinical practice:** Unit managers and clinical leaders should actively promote the importance of fluid balance. This can be done through positive reinforcement, showcasing cases where accurate monitoring improved patient outcomes, and involving staff in improving the process.
- ✓ **Further Research:** Investigate the gendered difference in knowledge scores through mixed-methods research. Explore the specific aspects of chart design that lead to perceptions of complexity and burden.

5.6. Limitations of the Study

This study has several limitations. First, the use of a self-reported practice score is susceptible to social desirability bias, where respondents may over-report adherence to best practices.

Second, the cross-sectional design captures a snapshot in time and cannot establish causality between the identified factors and practice.

Third, the study was conducted in a single center, which may limit the generalizability of the findings to other institutions with different cultures and resources.

CHAPTER SIX

6. CONCLUSION

In conclusion, this study demonstrates that healthcare professionals in this setting possess the necessary knowledge to perform accurate fluid balance monitoring. However, the translation of this knowledge into consistent practice is significantly influenced by their attitudes and, most critically, hindered by formidable systemic barriers. Therefore, efforts to improve fluid balance monitoring must be multi-faceted. While continued education is important, the highest yield interventions will likely come from systemic changes that reduce workload burdens, provide adequate resources, and foster a unit culture that values and enables this critical aspect of patient care (25, 28). Addressing the system rather than just the individual is the key to bridging the gap between knowledge and action.

REFERENCES

1. Welch K. Fluid balance. *Learn Disabil Pract*. 2010;13(6):33–8.
2. Diacon A. Fluid balance monitoring in critically ill patients. 2012;146.
3. Berthelsen PG, Cronqvist M. The first intensive care unit in the world. 2003;47:1190–5.
4. Controversies in Intensive Care Medicine [Internet]. Available from: <https://www.amazon.com/dp/3939069612>
5. Diacon A, Bell J. Investigating the recording and accuracy of fluid balance monitoring in critically ill patients. *South Afr J Crit Care* [Internet]. 2014;30(2):55. Available from: <http://www.sajcc.org.za/index.php/sajcc/article/view/193>
6. Schneider AG, Baldwin I, Freitag E, Glassford N, Bellomo R. Estimation of fluid status changes in critically ill patients: fluid balance chart or electronic bed weight? *J Crit Care* [Internet]. 2012;27(6):745.e7–745.e12. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S08833944112000032>
7. Aslam S, Afzal M, Kousar R, Waqas A, Gilani S. The assessment of nurses' knowledge and practices about fluid and electrolytes monitoring and administration among cardiac surgery patients: a case of Punjab Institute of Cardiology. *Int J Appl Sci Biotechnol*. 2017;5:208.
8. Shepherd A. Measuring and managing fluid balance. *Nurs Times*. 2011;107(28):12–6.
9. Scales K, Pilsworth J. The importance of fluid balance in clinical practice. *Nurs Stand*. 2008;22(47):50–7; quiz 58, 60.
10. Prowle JR, Bellomo R. Fluid administration and the kidney. *Curr Opin Crit Care* [Internet]. 2010;16(4):332–6. Available from: <https://insights.ovid.com/crossref?an=00075198-201008000-00008>
11. Samoni S, Vigo V, Bonilla Reséndiz LI, Villa G, De Rosa S, Nalesso F, et al. Impact of hyperhydration on mortality risk in critically ill patients: comparison between bioelectrical impedance vector analysis and cumulative fluid balance. *Crit Care* [Internet]. 2016;20(1):95. Available from: <http://ccforum.biomedcentral.com/articles/10.1186/s13054-016-1269-6>
12. Bellomo R, Cass A, Cole L, Finfer S, Gallagher M, Lo S, et al.; RENAL Replacement Therapy Study Investigators. An observational study of fluid balance and patient outcomes in the Randomized Evaluation of Normal vs Augmented Level of Replacement Therapy trial. *Crit Care Med*. 2012;40(6):1753–60.
13. Han PY. Factors predictive of intravenous fluid administration errors in Australian surgical care wards. *Qual Saf Health Care* [Internet]. 2005;14(3):179–84. Available from: <http://qualitysafety.bmj.com/lookup/doi/10.1136/qshc.2004.010728>
14. Silversides JA, Perner A, Malbrain MLNG. Liberal versus restrictive fluid therapy in critically ill patients. *Intensive Care Med* [Internet]. 2019;45(10):1440–2. Available from: <https://doi.org/10.1007/s00134-019-05713-y>
15. Bellomo R, Cass A, Cole L, Finfer S, Gallagher M, Lo S, et al.; RENAL Replacement Therapy Study Investigators. An observational study of fluid balance and patient outcomes in the Randomized Evaluation of Normal vs Augmented Level of Replacement Therapy trial. *Crit Care Med*. 2012;40(6):1753–60.
16. Han PY. Factors predictive of intravenous fluid administration errors in Australian surgical care wards. *Qual Saf Health Care* [Internet]. 2005;14(3):179–84.
17. Asfour HI. Fluid balance monitoring accuracy in intensive care units. *IOSR J Nurs Health Sci* [Internet]. 2016;5(4):53–62. Available from: <http://iosrjournals.org/iosr-jnhs/papers/vol5-issue4/Version-1/G0504015362>
18. Mank A, Semin-Goossens A, van der Lelie J, Bakker P, Vos R. Monitoring hyperhydration during high-dose chemotherapy. *Acta Haematol* [Internet]. 2003;109(4):163–8. Available from: <https://www.karger.com/Article/FullText/70964>
19. Gonzalez F, Vincent F. The fluid balance in critically ill patients: what are we talking about? *Minerva Anesthesiol*. 2011;77(8):766–7.

20. Asfour HI. Fluid balance monitoring accuracy in intensive care units. IOSR J Nurs Health Sci [Internet]. 2016;5(4):53–62. Available from: <http://iosrjournals.org/iosr-jnhs/papers/vol5-issue4/Version-1/G0504015362.pdf>
21. Kane-Gill SL, O'Connor MF, Rothschild JM, Selby NM, McLean B, Bonafide CP, et al. Adverse drug events in intensive care units: risk factors, impact, and the role of clinical pharmacists. *Crit Care Med*. 2017;45(2):377–85.
22. McDonald K. The importance of foundational knowledge for safe nursing practice. *Nurse Educ Today*. 2016;45:10–5.
23. Al-Moteri M. Nurses' knowledge of fluid balance assessment and monitoring in critical care settings. *Int J Nurs Sci*. 2020;7(4):403–8.
24. Smith J, Brown P, Lee R, Nguyen T. Gender differences in knowledge and attitudes among critical care nurses: implications for training and practice. *J Clin Nurs*. 2021;30(9–10):1425–33.
25. Johnson T, Lee R. Improving chart usability and clinical engagement in hospital settings. *J Health Inform*. 2019;25(4):233–40.
26. Chen L, Smith J, Patel R, et al. Challenges in accurate fluid output measurement among catheterized patients: a multicenter study. *J Clin Nurs*. 2023;32(7):1456–63.
27. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process*. 1991;50(2):179–211.
28. Kalisch BJ, Xie B. Errors of omission: missed nursing care in hospitals. *Jt Comm J Qual Patient Saf*. 2020;40(8):329–40.
29. World Health Organization. Patient safety: implementation manual for standards on communication and information transfer. Geneva: WHO; 2019.
30. Houghton C, Meskell P, Delaney H, Smalle M, Glenton C, Booth A, et al. Barriers and facilitators to healthcare workers' adherence to infection prevention and control guidelines for respiratory infectious diseases: a rapid qualitative evidence synthesis. *Cochrane Database Syst Rev*. 2020;4:CD013582.
31. Polit DF, Beck CT. Nursing research: generating and assessing evidence for nursing practice. 11th ed. Philadelphia: Wolters Kluwer; 2021.
32. Rosenberg AL, Dechert RE, Park PK, Bartlett RH. Association of cumulative fluid balance with outcomes in acute lung injury: a retrospective review of the ARDSnet tidal-volume study cohort. *J Intensive Care Med*. 2009;24(1):35–46.
33. Million T, Geda B, Yadeta TA, Mideksa L, Tura MR. Intravenous fluid administration practice among nurses and midwives in public hospitals of Central Ethiopia: a cross-sectional study. *Heliyon*. 2023;9(8):e18720.
34. Sisay A, Gobena T, Birhanu S, Yadeta TA. Attitude towards documentation and associated factors among nurses working in public hospitals of Hawassa City Administration, Southern Ethiopia. *SAGE Open Nurs*. 2021;7:23779608211015363.
35. Atsedemariam A, Abate A, Ayele M. Knowledge, attitude and practice towards nursing documentation among nurses in West Gojjam Zone public hospitals, Amhara, Ethiopia, 2018. *BMC Nurs*. 2019;18:38.
36. Tasew H, Mariye T, Teklay G. Nursing documentation practice and associated factors among nurses in public hospitals, Tigray, Ethiopia. *BMC Res Notes*. 2019;12:612.
37. Asfour HI. Fluid balance monitoring accuracy in intensive care units. IOSR J Nurs Health Sci. 2016;5(4):53–62.
38. Faculty of Intensive Care Medicine, Intensive Care Society. Guidelines for the Provision of Intensive Care Services (GPICS) Version 2.1. London: FICM & ICS; 2022.

ANNEX: QUESTIONNAIRES

ST. PAUL HOSPITAL MILLENNIUM MEDICAL COLLEGE, DEPARTMENT OF EMERGENCY MEDICINE AND CRITICAL CARE.

INFORMATION SHEETS, I am from SPHMMC. I will be conducting a study on KAP of Nurses towards fluid balance monitoring on critical ill patients in ICU at SPHMMC and AaBET hospitals for partial fulfillment requirement of Emergency and Critical Care Medicine Specialty. I am here to assess KAP of Nurses towards fluid balance monitoring on critically ill patients in ICU with associated factors between variables. I humbly request you to replay the questions. There are instructions on each section which will aid you though the process. The following are some general information about the study.

Objectives of the study: This study aim to assess Knowledge, Attitude and Practice of Nurses towards fluid balance monitoring on critical ill patients in ICU at SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia,

Confidentiality: All information taken from you will be kept confidential and won't be accessible to any third party; your name won't be registered on the question sheet, So that you will not be identified for any reason.

Benefits of the study: For your participation in the study no payment will be granted or has no any special privilege to you, but participating in the study and giving your genuine information will provide great input to bring change on Knowledge, Attitude and Practice of Nurses towards fluid balance monitoring on critical ill ICU patients.

Risks of the study: The study procedure does not bear any physical or psychological trauma. Furthermore, you will not be forced to respond or give information that you do not know.

Consent: Your participation in the study will be totally based on your willingness. You have the right not to participate from the beginning, or you may stop participating at any time after starting the participation.

Rights as a participant: If you have any questions about the study please be free to ask and contact me. Your participation in this study is voluntary and you can answer any individual questions or all of the questions concerning about your knowledge and attitude toward fluid balance monitoring on critically ill patients without confusion. In addition, I hope that you will be participating in this survey since your views are very important.

Informed consent, Are you voluntary to participate in this study? 1. Yes: 2. No

Instruction: Please respond to the following questions by encircling or put a ‘✓’ mark on the option you have

Part one: socio-demographic data of nurses working at SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, 2025.

S.no	Questions	Response categories	Remark
101	Age in years	-----	
102	Sex	1. Male 2. Female	
103	What is the highest level of education you have attained?	1. College diploma 2. Bachelor degree 3. MSc and above	
104	Years of experience (in years)	-----	
105	Monthly salary	Ethiopian Birr	

Part two: Assessing knowledge of nurses working in ICU at SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, 2025

201. Which one of the following is expected urine output in average adult person

- 1) 50 ml/kg /hour 2) 0.5 ml/kg/hour 3) 20 ml/kg /min 4) 5 ml/kg /hour

202. On average an adult patient requires a fluid intake (excluding solids) per day of approximately:

- 1) 500-1000 ml 2) 1000-1500 ml 3) 1500-2000 ml 4) 1500-2500ml

203. Clinical signs that most likely to occur in a patient who is in the state of hypervolemia

- 1) Dyspnea, tachypnea, tachycardia 2) Arrhythmia, dyspnea, desaturation
3) Anuria, thirst, hypertension 4) Hypotension, edema, petechial

204. What percentage of incorrect fluid balance Calculation do you consider acceptable when managing a critically ill patient:

- 1) 0-5%, in this case 0-100 ml 2) 5-10%, in this case 100 ml or more, less than 200 ml
3) 10-25%, in this case 200 ml or more, less than 500 ml 4) >25%, in this case 500 ml or more

205. Blood products are included in the fluid balance

- 1) Not sure 2) Yes
3) No 4) Depends on unit policy

206.do you calculate fluids that is given with drug as fluid input?

- 1) Yes 2) NO

207. During the past hour your patient has not passed any urine in the catheter bag. The first thing you do, is

- 1) Call the doctor 2) Check if the urinary catheter is free flowing
3) Remove the urinary catheter 4) Increase the infusion rate

208. among these three vital signs which one usually used as part of assessing your patient's fluid balance assessment:

- 1) Temperature, limb movements, heart rate
2) Fluid intake, urine production, nasogastric drainage
3) Urine production, GCS, respiratory rate

4) Blood pressure, pulmonary arterial wedge pressure, bowel activity

209. Fluid balance assessment does not include the following data:

1) Weight, central venous pressure, peripheral pulses

2) Electrolytes, edema, crackles

3) Vancomycin level, airway pressure, pupil reaction

4) Jugular vein distension, specific gravity changes, oxygen saturation

Part three: Attitude related questions of nurses working in ICU AT SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, 2025.

NO	Attitude Statements	Strongly disagree	disagree	agree	Strongly agree
301.	There are many other patient care activities that are more important for me to attend than recording the intake and output every Hour				
302.	There are too many people who fill in one patient's fluid balance chart				
303	As intensive care unit nurse I am responsible for more than one patient, and it is Difficult to supervise all the fluid balance activities				
304	I am satisfied with the design of the fluid Balance chart sheet. It is straightforward to complete				
305.	The space to write the fluid numbers on the chart is adequate				
306.	The final 24-hour fluid balance is correctly calculated all the time				
307.	Fluid balance assessment is important to guide ICU nursing care in critically ill patients				

308. Inaccurate fluid balance calculation can be a risk For the critically ill patient

309. Fluid balance information is recorded in too many different places on Critical care observation and patient records

Part Four: Practice of nurses working in ICU at SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, 2025.

NO	Practice Statements					
		Never	Rarely	Sometimes	Often	Always
401	I accurately measure and record all fluid intake (oral, IV, medications).					
402	I accurately measure and record all fluid output (urine, drains, vomit, and stool).					
403	I monitor and document hourly urine output for catheterized patients.					
404	I check the patency of urinary catheters before reporting low urine output.					
405	I adjust IV fluid administration based on patient condition and physician orders.					

406 I calculate daily fluid balance and identify positive or negative trends.

407 I report abnormal fluid balance (overload or deficit) promptly to the medical team.

408 I assess patients for clinical signs of fluid overload (edema, dyspnea, crackles).

409 I assess patients for clinical signs of fluid deficit (hypotension, tachycardia, dry mucous membranes).

Part Five.; Factors affecting fluid balance monitoring of nurses working at SPHMMC and AaBET hospitals in Addis Ababa, Ethiopia, 2025.

S no	Questions	Response categories	Remarks
501	Did you receive fluid balance monitoring standard training	1. Yes 2. No	If no go to Q 503
502	If yes for Q 501. When did you receive the training?	 years.....months ago	
503	Do you record fluid balance monitoring you have provided for all patients?	1. Yes 2. No	If yes go to Q505
504	If “No” to Q 503, what were your reasons? (more than one answer is possible)	1. I could not find adequate recording sheets 2. Unfamiliarity with standard of nursing fluid balance monitoring 3. Lack of skill 4. No adequate staff 5. Lack of time 6. No obligation from the hospital 7. No motivation from supervisors 8. Unsatisfied monthly income 9. If others, please specify	

505	On average for how many patients do you provide fluid balance monitoring per day?	patients
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506	Is fluid balance monitoring sheet easily available in your department?	1. Yes
		2. No
