



HAWASSA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCE

SCHOOL OF NURSING

**FLUID BALANCE MONITORING PRACTICE AND PREDICTORS AMONG NURSES
WORKING AT PUBLIC HOSPITALS IN HAWASSA CITY, ETHIOPIA, 2023**

BY: EYOB WONTE SHANKA (BSc)

**A THESIS SUBMITTED TO HAWASSA UNIVERSITY COLLEGE OF MEDICINE
AND HEALTH SCIENCE SCHOOL OF NURSING FOR PARTIAL FULFILLMENT OF
THE REQUIRMENT FOR THE MASTERS DEGREE IN EMERGENCY MEDICINE
AND CRITICAL CARE NURSING**

NOVEMBER, 2023

HAWASSA, ETHIOPIA

HAWASSA UNIVERSITY
COLLEGE OF MEDICINE AND HEALTH SCIENCE
SCHOOL OF NURSING
FLUID BALANCE MONITORING PRACTICE AND PREDICTORS AMONG NURSES
WORKING AT PUBLIC HOSPITALS IN HAWASSA CITY, ETHIOPIA, 2023

BY: EYOB WONTE SHANKA (BSc)

ADVISORS: Thomas Fako (MSc)

Alemneh Kabeta(PhD)

Declaration

I hereby declare that this MSc in Emergency Medicine and Critical Care Nursing Thesis entitled "Fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023" is my original work and has not been presented for a degree at any other university, and all sources of material used for this thesis have been acknowledged.

Name_____

Signature_____

Date_____

Advisors' approval sheet

This is to certify that the thesis on "Fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023," submitted to Hawassa University College of Medicine and Health Science School of Nursing for partial fulfillment of the requirement of a master's degree in Emergency Medicine and Critical Care Nursing, has been carried out by Eyob Wonte, ID No. GPECCNR/0007/14, under our supervision. Therefore, we recommend that the student has fulfilled the requirements and, hence, can submit the thesis to the School of Nursing.

Name of Principal advisor _____

Signature _____

Date _____

Name of Co-advisor _____

Signature _____

Date _____

Examiner's Approval Sheet

We, the undersigned, members of the Board of Examiners of the final open defense by Eyob Wonte Shanka have read and evaluated his thesis entitled "Fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023," and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree.

Name of internal Examiner I _____

Signature _____

Date _____

Name of internal Examiner II _____

Signature _____

Date _____

Name of external Examiner _____

Signature _____

Date _____

SGS Approval _____

Signature _____

Date _____

Acknowledgement

First of all, I would like to thank Hawassa University College of Medicine and Health Science, School of Nursing, for providing an opportunity to study in the area of my interest and conduct this graduate research project. I would also like to acknowledge the administrators of public hospitals in Hawassa City for their cooperativeness and willingness to provide relevant information. Last but not least, I would like to extend my heartfelt gratitude to my advisors, Mr. Thomas Fako and Dr. Alemneh Kabeta, for their continuous support, encouragement, guidance, useful criticisms, and constructive comments throughout the study.

Tale of contents

Table of Contents

Declaration	ii
Advisors' approval sheet.....	iii
Examiner's Approval Sheet	iv
Acknowledgement	v
List of tables.....	ix
List of figures	x
Abbreviations and Acronym	xi
Abstract	xii
CHAPTER ONE	1
1. INTRODUCTION	1
1.1. Background	1
1.2. Statement of the problem	3
1.3. Significance of the study.....	5
1.4. Research questions.....	5
CHAPTER TWO	6
2.1. Nurses Practices towards fluid balance monitoring.....	6
2.2. Associated factors towards fluid balance monitoring.....	6
2.2.1. Socio-demographic factors towards fluid balance monitoring	7
2.2.2. Organizational factors towards fluid balance monitoring.....	7
2.2.3. Knowledge of nurses towards fluid balance monitoring	8
2.2.4. Attitude of nurses towards fluid balance monitoring.....	9
2.2.5. Conceptual Framework.....	10
CHAPTER THREE	11
3. OBJECTIVES	11
3.1. General objective	11
3.2. Specific objectives	11
CHAPTER FOUR.....	12

4. MATERIALS AND METHODS.....	12
4.1. Study area.....	12
4.2. Study Design and Period.....	12
4.3. Source and Study population	13
4.3.1. Source population	13
4.3.2. Study population	13
4.3.3. Study unit	13
4.4. Eligibility Criteria	13
4.4.1. Inclusion Criteria	13
4.4.2. Exclusion Criteria	13
4.5. Sample size determination and procedure	13
4.5.1. Sample size determination	13
4.5.2. Sampling method and procedure	14
4.6. Study variables.....	15
4.6.1. Dependent variable	15
4.6.2. Independent variables	15
4.7. Operational Definition	16
4.8. Data collection tools and procedure.....	16
4.9. Data quality assurance	17
4.10. Data processing and Statistical analysis	17
4.11. Ethical consideration.....	18
4.12. Dissemination and utilization of results.....	18
CHAPTER FIVE	19
5. RESULT	19
5.1. Socio-demographic characteristics of the participants	19
5.2. Respondent’s knowledge about fluid balance monitoring.....	20
5.3. Attitude of respondents towards fluid balance monitoring practice	21
5.4. Fluid balance monitoring practice of nurses	23
.....	26
5.5. Reasons for not performing fluid balance monitoring practice among nurses	26
5.6. Factors associated with the fluid balance monitoring practice of respondents.....	27

CHAPTER SIX.....	29
DISCUSSION	29
CHAPTER SEVEN	30
STRENGTH AND LIMITATIONS OF THE STUDY	30
7.1. Strength of the study	30
7.2. Limitations of the study	30
CHAPTER EIGHT	31
CONCLUSION AND RECOMMENDATION.....	31
8.1. Conclusion	31
8.2. Recommendation	31
REFERENCES	32
Annex I: English Version Participant Information Sheet and Informed Voluntary Consent for Health Professionals.....	35
Annex II: Letter of ethical clearance from Institutional Review Board of Hawassa University College of Medicine and Health Science.....	41

List of tables

Table 1: Scio-Demographic data of nurses working at public hospitals in Hawassa city, Ethiopia, 2023(N=270).....	19
Table 2: Assessing of Knowledge of fluid balance monitoring practice among nurses working at public hospitals in Hawassa city, Ethiopia, 2023(N=270).....	20
Table 3: Assessing attitude related questions of nurses towards fluid balance monitoring practice working at public hospitals in Hawassa city, Ethiopia, 2023(N=270)	22
Table 4: Assessing fluid balance monitoring practice of nurses working at public hospitals in Hawassa city, Ethiopia, 2023(N=50).....	24
Table 5: Reasons for not performing fluid balance monitoring practice among nurses working at public hospitals in Hawassa city, Ethiopia, 2023(N=270).....	27
Table 6: Bivariate and multivariate logistic regression for factors associated with fluid balance monitoring practice among nurses working at public hospitals in Hawassa city, Ethiopia, 2023 (N = 50).....	28

List of figures

Figure 1: Conceptual framework adapted from the literatures(Mengistu, 2020)and (Asfour, 2016) to assess fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023.....	10
Figure 2: Schematic diagram of the sampling procedure for nurses working at public hospitals in Hawassa City	15
Figure 3: Knowledge of nurses working at public hospitals in Hawassa City, Ethiopia, 2023....	21
Figure 4: Attitude of nurses working at public hospitals in Hawassa City, Ethiopia, 2023	23
Figure 5: Practice of nurses working at public hospitals in Hawassa City, Ethiopia, 2023	26

Abbreviations and Acronym

AOR	Adjusted Odds Ratio
BSc	Bachelor science
CI	Confidence Interval
EOPD	Emergency outpatient department
ETB	Ethiopian birr
ICUs	Intensive Care Units
IFL	Insensible fluid loss
IV	Intravenous
Kg	Kilogram
ml	Milliliter
MSc	Master's science
NICU	Neonatal intensive care unit
OR	Odd Ratio
SD	Standard Deviation
SPSS	Statistical package for social science
WSUCSH	Wolaita Sodo University Comprehensive Specialized Hospital

Abstract

Background: Fluid balance monitoring involves measuring input and output accurately. In order to treat patients effectively and shorten their hospital stays, accurate fluid balance monitoring is necessary. Recent studies have shown that the majority of fluid balance monitoring practices by nurses are unsatisfactory. There was an apparent gap in recording input and output and calculating 24-hour fluid balance by nurses. Although some studies on fluid balance monitoring have been conducted, fluid balance monitoring practice among nurses is still poorly understood.

Objective: To assess fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa city, Ethiopia, 2023.

Methodology: A cross-sectional study was conducted from May 1 to June 30, 2023. A simple random sampling technique was used to select 270 nurses. A checklist for observations and a self-administered questionnaire were used to gather the data. The data was summarized using descriptive statistics. To find the predictors of fluid balance monitoring, bivariate and multivariable logistic regressions were employed.

Results: Of all the nurses ($n = 270$) who participated in the study, 170 (63%) reported that they do not perform fluid balance monitoring. Sex was associated negatively (AOR = 0.153: 0.024, 0.981, $p = 0.048$), whereas knowledge was associated positively (AOR = 19.029: 3.053, 118.601, $P = 0.002$) with fluid balance monitoring practice and was found to be a predictor of fluid balance monitoring practice.

Conclusion and recommendation: More than half of nurses assessed for fluid balance monitoring practice scored less than the mean score for practice-related questions. The knowledge of the respondent nurses was found to be a predictor of fluid balance monitoring practice. Provision of continuous and periodic training on the knowledge related to fluid balance monitoring practice for nurses working in public hospitals in Hawassa city has to be strengthened.

Key words: Attitude, Fluid balance monitoring, Knowledge, Practice, Nurses

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Monitoring the patient's fluid balance is a crucial aspect of the process of caring for critically ill patients. Fluid balance is the balancing of fluid intake and output to enable proper metabolic activity(Welch, 2010). As adults, our bodies are mostly fluids. Body fluids continuously move waste products away from the cells and carry nutrients, electrolytes, and oxygen to the cells(Shumaila Aslam 1, 2017, Taylor C., 2015). All fluids consumed by the body through the mouth, including oral fluids, intravenous drugs or solutions, nasogastric tube feedings, and total parenteral nutrition, are referred to as fluid intake. Fluid output refers to the total amount of fluids that leave the body through urinals, feces, vomiting, aspiration through nasogastric tubes, insensible losses, surgical wound drainage, and chest drains. When fluid intake and fluid output are equal, there is fluid balance(Abd Elalem and Fouad, 2018).

The formula can be used to determine insensible loss while taking into account the intubation state and maximum body temperature. Insensible fluid loss (IFL) (milliliters) = $800 + 20\% \times 800 \times (\text{maximum temperature} - 37)$. This value was divided by 2 if the patient was intubated, and fluid intake may vary from 1.5 to 2.5 liters per day, and urine output must be at least 0.5 ml/kg/hour in an average-sized adult, but it needs to consider what is taken while monitoring (Schneider *et al.*, 2012). According to a study, both a positive and negative fluid balance are associated with mortality that lasts for a year (Balakumar *et al.*, 2017).

Accurately measuring body fluids is the main task of nurses working in the Intensive Care Unit (ICU), as patients complain of serious problems affecting bodily function. Therefore, the nurse should monitor and assess body fluids and determine the balance between fluid intake and output to prevent patient complications(Gonzalez and Vincent, 2011). Managing patients' fluid balance is as equally important as carrying out any other patient care activity for the critically ill patients(Herbert *et al.*, 2016). The study found a positive correlation between positive fluid balance and hospital mortality in critically ill patients with sepsis and septic shock(Pittard *et al.*, 2017).

Inaccurate measurement of input and output can cause many complications, like hypervolemia, hypovolemia, hypernatremia, hyponatremia, hyperkalemia, and hypokalemia. All these complications will make the prognosis of the patients poor and increase the mortality rate(Johnson, 2016). According to the study done at Mansa General Hospital in Zambia, there was an apparent gap in recording input and output by nurses(Mwila, 2016). More than 25% of fluid balance records include a difference between the researchers' calculation and the recorded calculation, and this difference was greater than 500 ml(Scales and Pilsworth, 2008). A study done in South Africa at Stellenbosch University showed poor fluid balance monitoring practice by nurses due to unfavorable attitudes of nurses and insufficient knowledge towards fluid balance monitoring, a low nurse-to-patient ratio, a lack of in-service training, a lack of guidelines, and a shortage of time and work load(Diacon, 2012).

1.2. Statement of the problem

Fluid balance monitoring is a part of nurse practice. A study done by (Pittard et al., 2017) showed that 72 hours of fluid balance were linked with the likelihood of developing multiple organ failure syndromes in septic patients. A study done at St. Mary's Hospital-Mayo Medical Center in Rochester, Minnesota, on 307 subarachnoid hemorrhagic patients showed a positive fluid balance was strongly associated with a poor functional outcome(Kissoon et al., 2015). The systematic review and meta-analysis found a positive link between the amount of positive fluid balance and death in critically ill patients, with an adjusted relative risk for fluid overload of 2.79 (95% CI, 1.55–5.00) and 1.39 (95% CI, 1.15–1.69) for cumulative fluid balance(Messmer *et al.*, 2020).

A cohort study done in Europe and Australia on TBI patients aged 16 years and older who had brain CT scans from 55 hospitals in 18 countries showed an association between higher mean daily fluid input, higher ICU mortality, and worse functional outcome(Eveline Janine Anna Wiegers et al., 2021). A study done at Mansoura University Emergency Hospital in three ICUs using a descriptive exploratory research design revealed that only 40% of nurses were competent in calculating and recording 24-hour intake and output fluids(Mansour, 2019). Inaccurate fluid balance monitoring and inaccurate fluid balance recording can become critical for the survival of patients(Elliott and Coventry, 2012). The study showed that about 30.5% of patients' fluid charts have no information documented, 69.5% of patients' fluid charts have some information documented, and 0% are fully documented (Elizabeth Thompson, 2020).

In a study conducted in ICUs across three purposefully selected hospitals in South Africa, the majority (68.9%) of audited 24-hour fluid balance calculations were shown to be inaccurate(Diacon and Bell, 2014). In a study done in two general ICUs at a selected hospital in Alexandria, Egypt, 35% of recorded input and output in patient folders were inaccurate(Asfour, 2016). A cross-sectional study done in Addis Abeba, Ethiopia, showed that 43.7% of nurses' practice was poor based on overall practice done through observation of nurses who were working in the ICU of federally administered government hospitals(Mengistu, 2020).

A single study was conducted in our country on 126 ICU nurses in Addis Abeba, the capital of Ethiopia, examining their knowledge, attitude, practice, and associated factors towards fluid balance monitoring. No study was conducted on the fluid balance monitoring practices and predictors among nurses working in any healthcare facility in Hawassa City. In this study, nurses' practice of fluid balance monitoring at public hospitals in Hawassa city was evaluated quantitatively, predictive variables of nurses' practice were discovered, and recommendations for remedies to the problems were made.

1.3. Significance of the study

The results of recent investigations have demonstrated a positive link between critically ill patients' deaths and both positive and negative fluid balances. This study evaluated the fluid balance monitoring practices of nurses working at public hospitals in Hawassa City and identified predictive factors related to those practices. There was no previous study conducted in this study area, and little was known about fluid balance monitoring practices in our country. The study primarily benefited nurses and patients who were in need of fluid balance monitoring by providing crucial evidence on the current fluid balance monitoring practices of nurses in public hospitals in Hawassa City.

The findings of the study will aid the ministry of health, health facilities, and administrative organizations in developing strategies, planning, and delivering in-service training to enhance the standard of documentation and the precision of fluid input and output measurements made by nurses. The findings of this study provide baseline data for other researchers to do further research on fluid balance monitoring practices as well as for policymakers to plan interventions.

1.4. Research questions

1. What is the current fluid balance monitoring practice of nurses working at public hospitals in Hawassa City?
2. What are predictors of fluid balance monitoring practice of nurses working at public hospitals in Hawassa City?

CHAPTER TWO

2. LITERATURE REVIEW

The accurate fluid balance monitoring is required for the effective management of the patients. Fluid balance is the concept that the amount of fluid lost is equal to the amount of fluid taken in. Calculation of fluid balance involves measuring the amount of fluid entering to the body and comparing it with the amount of fluid leaving the body to determine body fluid status(Simpson and McIntosh, 2021). According to the findings of the descriptive study done on registered nurses, 22.6% of respondents disagreed with the accurate fluid and electrolyte balance monitoring by nurses in cardiac surgery patients in the final 24 hours(Shumaila Aslam I, 2017).

2.1. Nurses Practices towards fluid balance monitoring

A descriptive research done in intensive care units in Damietta general hospital among 72 nurses had shown that 97.2% of nurses had an unsatisfactory level of practice regarding fluid and electrolyte balance monitoring and management(Sobeh, 2021). A cross-sectional study conducted at Maternity and Children Hospital, Makka City, Saudi Arabia, on 66 nurses showed that 93.9% of nurses calculate and document 24 hour fluid balance correctly(Sayed, 2022). The majority of the studied group of nurses had poor performance levels during the pre-educational program and constituted 80%, while they have good performance levels constituted 75% and 67.5 percent after one and three months' educational programs, respectively(Weheda *et al.*, 2020). The audit which was organized to evaluate the degree of arithmetic error in fluid balance records in Hawke's Bay Intensive Care Unit (ICU) revealed that 70.1% of all audited fluid balance charts were considered accurate, with a tolerated deviation from true fluid status of 0-10 ml (Bird *et al.*, 2021).

More than half of the studied nurses scored good performance (56.3%), whereas 43.7% had poor performance based on overall practice done through observation of nurses who were working in the ICU of federally administered governmental hospitals in Addis Abeba(Mengistu, 2020).

2.2. Associated factors towards fluid balance monitoring

According to the quantitative and qualitative data collected and analyzed at Homerton Hospital in 2020, fluid status monitoring is poorly documented by nurses. Barriers to accurate monitoring were identified as time constraints, poor handovers, poor staff education and confidence(Thompson *et al.*, 2020).

Therefore, identifying factors affecting fluid balance monitoring practice is very important to increase the accuracy in fluid balance monitoring practice of nurses, which improves patients' outcomes and prevents complications of fluid imbalance.

2.2.1. Socio-demographic factors towards fluid balance monitoring

The literature revealed that 74.7% of participant nurses were female, 67.1% of nurses were aged 25-35 years, 44.3% of nurses followed the Technical Institute of Nursing, 66% of studied nurses didn't take fluid balance training, and 39.2% of participant nurses had 5 to 10 years of work experience (Abd Elalem and Fouad, 2018). The findings of the study done in Egypt using a quasi-experimental research design to evaluate the nurses' performance and patients' outcomes after a nursing program about hydration status management had shown that 45% of the studied nurses had an age of 30 years, 55% of the participant nurses were males, 57.5% had a nursing diploma degree, 17.5% were graduates of a nursing technical institute, and 87.5% of the participant nurses had attended a fluid balance shop previously or near the study time (Weheda *et al.*, 2020).

The findings of the study showed that nurses with an age of more than 28 years had 3.9 times good practice (OR = 3.95, p 0.001), and nurses paid with a monthly salary of greater than 5000 ETB had 4.2 times good fluid balance monitoring practice than those nurses paid less than 5000 ETB (Mengistu, 2020).

2.2.2. Organizational factors towards fluid balance monitoring

Adequate time is required for accurate fluid balance documentation, and insufficient time may lead to incorrect documentation, and thus the patient's safety may be compromised (Scales and Pilsworth, 2008). Fluid balance recording is usually inadequate or inaccurate because of staff shortages, a lack of training, or a lack of time (Mogileeswari and Ruth, 2016). According to the study conducted at Maternity and Children Hospital, Makkah City, Saudi Arabia, the majority of the studied nurses reported that inaccuracy of the measuring equipment (90.9%), time management (87.9%), and workload (81.8%) were factors affecting fluid balance monitoring.

The findings of the study also showed that 57.6% of studied nurses did not participate in any previous training program (Sayed, 2022). Inaccuracy of the measuring equipment or continuous intravenous infusions, time management (100%), workload (91.67%), and lack of skills or training (33.33%) were factors affecting fluid balance monitoring as reported by nurses (Asfour, 2016).

The findings of the study done in Egypt using a quasi-experimental research design to evaluate the nurses' performance and patients' outcomes after a nursing program about hydration status management showed that there were highly statistically significant differences between pre and post educational programs regarding fluid balance practice performance by nurses working in medical, neurological, and urology departments at Minia University Hospital(Weheda *et al.*, 2020).

2.2.3. Knowledge of nurses towards fluid balance monitoring

In a study conducted in the intensive care unit of Benha University Hospital, there was a highly statistically significant relation between the total knowledge score of nurses and their practices level regarding body fluid balance assessment both pre and post program implementation; this means that when knowledge increased, satisfactory nursing practice improved(Abd El-SalamSheta and Mahmoud, 2018).

Assessment of nurses' knowledge with regard to fluid and electrolyte balance is a must in order to identify their errors in administration and to plan further training classes to improve their knowledge(Shumaila Aslam 1, 2017). The finding revealed that there was a statistically significant relation between nurses' knowledge score and level of practice regarding body fluid balance assessment post intervention(Abd Elalem and Fouad, 2018).

A study done in two general intensive care units (ICUs) at a selected hospital in Alexandria, Egypt, found that more than a third of nurses had inadequate knowledge related to measuring fluid input and output, so in-service education should be conducted to improve nurses' knowledge(Asfour, 2016).

An institutional-based cross-sectional study done in federally administered hospitals in Addis Abeba, Ethiopia, had shown the strong association and positive relationships between practices and knowledge of nurses towards fluid balance monitoring. Those nurses who have good knowledge of fluid balance monitoring are 7.35 times more likely to have good practice than nurses with poor knowledge (OR = 7.33, CI 3.57-15.062, and a P-value of less than 0.01 level)(Mengistu, 2020).

2.2.4. Attitude of nurses towards fluid balance monitoring

The study revealed the correlation between nurses' perception and practice of monitoring input and output ($r=.73$, $p<0.001$) (Kang, 2016). The result of the study indicated that nurses' perception regarding fluid balance monitoring is positive, as half of the studied nurses agreed that recording the intake and output is as important as recording patient care activities (51.5%), fluid assessment is important to guide nursing care in critically ill patients (56.1%), and inaccurate fluid calculation is a risk for the critically ill patient (57.6%). Approximately one third of the sample agreed that fluid balance monitoring is the responsibility of nurses (33.3%), and the nurse is the only person responsible for fluid calculation (31.8%) (Mogileeswari and Ruth, 2016). The findings of the study done in two general intensive care units (ICUs) at a selected hospital in Alexandria, Egypt, showed that 71% of nurses had favorable perceptions regarding fluid balance monitoring in ICUs (Asfour, 2016).

2.2.5. Conceptual Framework

After reviewing various literatures on fluid balance monitoring practice, the conceptual framework was adapted (Mengistu, 2020) and (Asfour, 2016). The conceptual framework demonstrates how dependent and independent variables are related. When independent variables have a negative effect on dependent variables, it shows that nurses working at public hospitals in Hawassa city are inaccurately monitoring fluid balance.

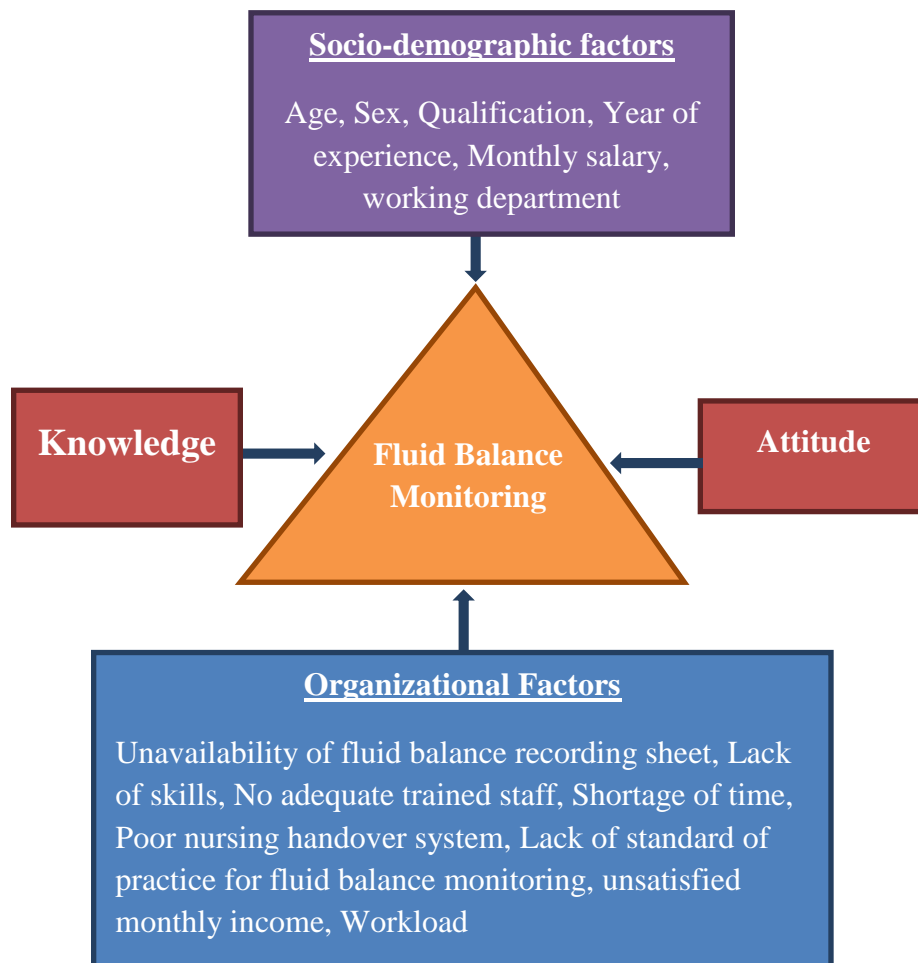


Figure 1: Conceptual framework adapted from the literatures(Mengistu, 2020)and (Asfour, 2016) to assess fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023.

CHAPTER THREE

3. OBJECTIVES

3.1. General objective

- To assess fluid balance monitoring practice and identify predictors among nurses working at public hospitals in Hawassa city, Ethiopia, in 2023.

3.2. Specific objectives

- ❖ To assess current fluid balance monitoring practice among nurses working at public hospitals in Hawassa City.
- ❖ To identify predictors of fluid balance monitoring practice among nurses working at public hospitals in Hawassa City.

CHAPTER FOUR

4. MATERIALS AND METHODS

4.1. Study area

The study was carried out in Hawassa City, Ethiopia. Hawassa city is 275 km south of Addis Ababa, the capital of Ethiopia, 130 km east of Wolaita Sodo, and 75 km north of Dilla. The town serves as the capital of the Sidama Region. According to the report of housing and population census, the projected population of Hawassa City population in 2018 was estimated to 367,908 and comprises about 75,084 household. The City has 4 governmental hospitals, 12 government health centers and 13 health posts. Further, there are 4 private hospitals, 2 private special clinics and 44 private clinics.

Hawassa University Comprehensive Specialized Hospital found in Hawassa City and serving people of the region and patients coming from the nearby Oromia Region by different outpatient, inpatient, and emergency units (surgery, gynecology and obstetrics, internal medicine, pediatrics, ophthalmology, psychiatry, radiology, pathology, and Microbiology). It serves a catchment population of over 18 million(Mechal et al., 2021, Bedry and Tadele, 2020). Adare General Hospital is found in Hawassa city. It was established in 1962 in the name of Hawassa clinic. In 2011, it was upgraded to Adare Primary Hospital and now it is known as Adare General Hospital. Currently, the hospital serves about 1,368,341 people(Andarge et al., 2021). Tula General Hospital and Motitte Furra Primary hospital are also governmental hospitals found in Hawassa City.

4.2. Study Design and Period

Institutional based quantitative cross sectional study design was used. The study was conducted from May to June, 2023.

4.3. Source and Study population

4.3.1. Source population

Nurses working at public hospitals in Hawassa City, Ethiopia

4.3.2. Study population

All randomly selected nurses during data collection worked in Adult EOPD, Pediatrics EOPD, ICU, NICU, Medical Ward, Surgical Ward, pediatrics Ward and urological Ward at public hospitals in Hawassa City.

4.3.3. Study unit

An individual nurse who was randomly selected during data collection

4.4. Eligibility Criteria

4.4.1. Inclusion Criteria

- All nurses who were directly involved in patient care management

4.4.2. Exclusion Criteria

- Nurses who have less than six months of work experience or are not involved in clinical care

4.5. Sample size determination and procedure

4.5.1. Sample size determination

Sample size was determined by using the formula of single population proportion with a p-value of 50% (since no previous study has been done using a similar sampling method), a marginal error of 5%, and a confidence interval of 95% and calculated as follows:

$$n = \frac{(Z \alpha/2)^2 p(1-p)}{d^2}$$

$$n = \frac{(1.9)^2 \times 0.5(1-0.5)}{(0.05)^2} = 384$$

Where: **n**=Sample size

Z α/2 =Value corresponding to a 95% level of significance=1.96

p=50%

d=Margin of error, assumed to be 5%

Since the number of nurses working at public hospitals in Hawassa city was less than 10,000(N=774), correction formula was used:

$$nf = \frac{n}{1 + \frac{n}{N}} = \frac{384}{1 + \frac{384}{774}} = 256$$

By assuming nonresponse rate, 5% of sampled population was taken, and the total sample size (nt) was:

$$nt = 256 + 14 = 270$$

Where: N= the total number of nurses working at public hospitals in Hawassa city

nf= final sample size after correction formula used.

4.5.2. Sampling method and procedure

A simple random sampling method was used to select 270 nurses randomly from Hawassa University Comprehensive Specialized Hospital, Adare General Hospital, Tula General Hospital, and Motitte Furra Primary Hospital. The total number of nurses working in four public hospitals in Hawassa city was 774, and the sample size calculated was 270 using the single population proportion formula. The total sample size was used to allocate each public hospital proportionally. Finally, each nurse was selected randomly from each hospital using a simple random sampling method.

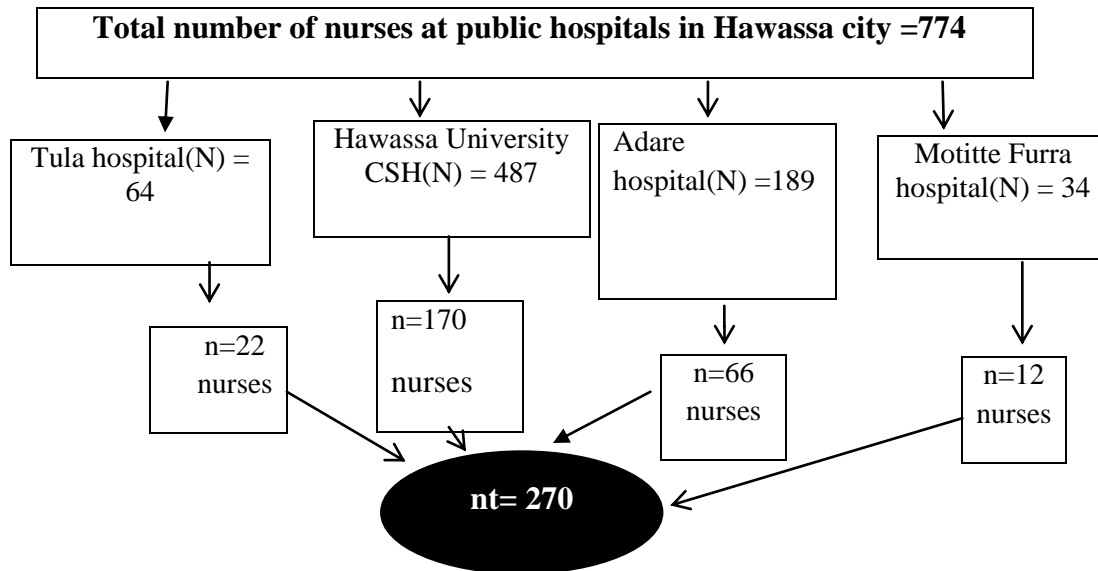


Figure 2: Schematic diagram of the sampling procedure for nurses working at public hospitals in Hawassa City

CSH: Comprehensive Specialized Hospital, N: total number of nurses in each hospital, n: number of randomly selected nurses from each hospital, nt: total sample size

4.6. Study variables

4.6.1. Dependent variable

- Fluid balance monitoring practice

4.6.2. Independent variables

- Socio-demographic factors
 - Age
 - Sex
 - Qualification
 - Year of experience
 - Monthly salary
 - Working department
- Knowledge
- Attitude
- Organizational factors
 - Workload
 - Time constraints
 - Inaccuracy of measurement equipment
 - Poor handover system
 - Availability of guidelines
 - Fluid balance training

4.7. Operational Definition

Attitude of fluid balance monitoring: indicates belief of nurses working at public hospitals in Hawassa City.

Favorable attitude: nurses' score which is more than mean score of attitude related likert scale questionnaire towards fluid balance monitoring.

Unfavorable attitude: nurses' score which is less than mean score of attitude related likert scale questionnaire towards fluid balance monitoring.

Good knowledge: refers to the level of knowledge when nurses working in public hospitals score more than mean score of knowledge related questionnaire towards fluid balance monitoring.

Poor knowledge: refers to the level of knowledge when nurses working in public hospitals score less than mean score of knowledge related questionnaire towards fluid balance monitoring.

Fluid balance monitoring: measuring input and output fluid accurately and net consciously.

Practice of fluid balance monitoring: refers to the level of nurses' performance regarding accurate measurement of input and output fluid at appropriate time in all admitted patients.

Good practice: when nurses working in public hospitals in Hawassa City score more than mean score of observational checklist questionnaire towards fluid balance monitoring.

Poor practice: when nurses working at public hospitals in Hawassa City score less than mean score of observational checklist towards fluid balance monitoring.

Time constraints: shortage of time to record input and output.

4.8. Data collection tools and procedure

The study tools were adapted from (Mengistu, 2020, Asfour, 2016, Weheda et al., 2020, Shumaila Aslam I, 2017, Mohamed et al., 2018) to assess fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, in 2023. The English version questionnaires were used and had five parts: socio-demographic characteristics of participants (six questions), knowledge (ten questions), attitude (ten questions), and associated factors (four questions), through self-administered questionnaires, and practice (twenty questions) through an observational checklist. Self-administered questionnaires were used to collect data from nurses working in Adult EOPD, Pediatrics EOPD, ICU, NICU, Medical Ward, Surgical Ward, pediatrics Ward and urological Ward.

An observational checklist was used to assess fluid balance monitoring practice for 50 nurses working in the intensive care unit, neonatal intensive care unit, and adult emergency outpatient department due to the impracticability of fluid balance monitoring practice by nurses in the other working areas of the hospitals. Personnel included for data collection were three BSc nurses with clinical experience of one year and above; one MSc nurse in adult health nursing, and one MSc nurse in emergency and critical care nursing, who were selected purposefully as supervisors by the principal investigator.

4.9. Data quality assurance

To assure the quality of the data, the following measures were taken: Two weeks prior to actual data collection, questionnaires were pretested using 5% of the study population in Wolaita Sodo University Comprehensive Specialized Hospital (WSUCSH) by the investigator, which was out of the study population, for clarity, understandability, and completeness of the questionnaires. Two days of training were given to all data collectors and supervisors to increase the quality of the data, ensure that all data collectors and supervisors have the same understanding and knowledge about the data collection tools, and follow the same procedure. In addition to this, during the actual data collection, supervisors checked for consistency, completeness, and any missing data. Data cleaning for inconsistency, missing values, and amendments were considered as needed before analysis.

4.10. Data processing and Statistical analysis

The raw data was coded and transferred into a coding sheet. Epi-data version 4.6 was used for data entry, and the data was exported to Statistical Package for Social Science (SPSS) version 20 software for data analysis. Output data was checked against the revised coded data for typing and spelling mistakes. Descriptive statistics, including frequency distribution and percentage were used to describe different respondents' characteristics. Strongly agree and agree become agree, and strongly disagree and disagree become disagree. The scoring system for questions assessing the attitude of nurses towards fluid balance monitoring depends on a 5-point Likert scale ranging from (strongly disagree = 1), (disagree = 2), (uncertain = 3), (agree = 4), to (strongly agree = 5). For knowledge-related questions, the scoring system was 1 for correct response and 0 for incorrect response, and those who performed practice scored 1 and those who did not perform practice scored 0.

Bivariate and multivariable logistic regressions were used. Normality of distribution of data was checked for all variables using the Shapiro-Wilk test ($p > 0.36$), Kolomogorov-Smirnov ($p > 0.8$), histogram, normal Q-Q plots, and box plots visualization, which showed normal distribution of data. Variables with a p-value of $p < 0.25$ in the bivariate analysis were candidates for multivariable logistic regression.

Multivariable analysis was carried out for confounder adjustment after a model fitness test was done with the Hosmer-Lemeshow test and was not significant ($p=0.792$) and those with a p-value of 0.05 in the multivariable analysis were regarded as having a statistically significant association. Multi-collinearity was checked to see the linear correlation among the independent variables by using the variance inflation factor and tolerance (t), (Variance inflation factor (VIF) for all variables was greater than 1.5 and no variable has tolerance (T) < 0.57 . Adjusted Odds Ratio along with 95% CI was estimated to find out associated factors affecting fluid balance monitoring practice of nurses.

4.11. Ethical consideration

Ethical clearance letter (Ref.No. IRB/300/15) was obtained from an Institutional Review Board (IRB) of Hawassa University, College of Medicine, and Health Science. Letters of permission were obtained from administrators of public hospitals in Hawassa city. The study participants were informed and informed consent was obtained. All obtained informations were held with confidentiality to be used for intended purpose. The participants can refuse or interrupt participation at any step.

4.12. Dissemination and utilization of results

The result of the study was presented to Hawassa University College of Medicine and Health Science School of nursing. Finally the result will be disseminated to public hospitals in Hawassa City to enable them to make consideration during planning and policy making to improve fluid balance monitoring practice. At last, attempt will be made to publish in peer-reviewed journal for further dissemination.

CHAPTER FIVE

5. RESULT

5.1. Socio-demographic characteristics of the participants

All 270 eligible participants participated in the study, with a response rate of 100%. About 184 (68.1%) of the participants were aged thirty years or older. Among the respondents, more than half were males (54.1%) and married (54.4%). In terms of the level of education attained in nursing, 199 (73.7%) of respondents had a bachelor degree in comprehensive nursing, and 177 (65.6%) had work experience of five years or more.

Table 1: Scio-Demographic data of nurses working at public hospitals in Hawassa City, Ethiopia, 2023(N=270)

Variables	Category	Frequency	Percentage
Age in completed years	<30 years	86	31.9
	≥30 years	184	68.1
Sex	Male	146	54.1
	Female	124	45.9
Marital status	Married	147	54.4
	Single	120	44.4
	Divorced	2	0.7
	Widowed	1	0.4
Highest level of education attained in nursing	Diploma in Clinical Nurse	1	0.4
	BSc in Comprehensive Nursing	199	73.7
	BSc in Emergency and critical care Nursing	17	6.3
	BSc in Pediatrics and Child Health nursing	27	10.0
	BSc in surgical nursing	12	4.5
	BSc in Medical nursing	6	2.3
	MSc in Emergency and critical care nursing	2	0.7
	MSc in Adult Health nursing	4	1.5
Work experience	<5 years	93	34.4
	≥5years	177	65.6
Gross monthly salary	<7000 ETB	40	14.8
	≥7000 ETB	230	85.2
Working department or unit	Adult EOPD	49	17.4
	ICU	40	14.8
	Medical Ward	53	19.6
	NICU	13	4.8
	Pediatrics EOPD	22	8.1
	Pediatrics Ward	41	15.2
	Surgical Ward	49	18.1
	Urological Ward	5	1.9

5.2. Respondent’s knowledge about fluid balance monitoring

From 270 respondents, about two-thirds, 173 (64.1%) gave an incorrect response to the average adult patient’s requirement for fluid intake per day. Six out of ten (61.5%) nurses incorrectly responded for an acceptable percentage of incorrect fluid balance calculations. This study indicated that 205 (75.9%) nurses responded correctly to the first thing to do if the patient has not passed any urine in the catheter bag over the past one hour. Among the respondent nurses, 144 (53.3%) incorrectly responded for three vital signs usually used to assess fluid balance. From the total respondents (270), 161 (59.6%) nurses scored below the mean score of correct responses given by the nurses for knowledge-related questions, referred to as poor knowledge.

Table 2: Assessing of Knowledge of fluid balance monitoring practice among nurses working at public hospitals in Hawassa City, Ethiopia, 2023(N=270)

Variables	Response category	Frequency	Percentage
When does fluid balance exist?	Correct	135	50
	Incorrect	135	50
Expected urine output in average adult patient	Correct	131	48.5
	Incorrect	139	51.5
Average adult patient’s requirement of fluid intake perday	Correct	97	35.9
	Incorrect	173	64.1
Clinical signs in the state of hypervolemia	Correct	147	54.4
	Incorrect	123	45.6
Acceptable percentage of incorrect fluid balance calculation	Correct	104	38.5
	Incorrect	166	61.5
Fluid balance includes blood products	Correct	123	47
	Incorrect	147	53
Input fluid includes fluid given with drug	Correct	155	57.4
	Incorrect	115	42.6
First thing to do if the patient has not passed any urine in the catheter bag over the past one hour	Correct	205	75.9
	Incorrect	65	24.1
Three vital signs usually used to assess fluid balance	Correct	126	46.7
	Incorrect	144	53.3
Data not included in fluid balance assessment	Correct	146	54.1
	Incorrect	124	45.9
Knowledge category	Good	109	40.4
	Poor	161	59.6

The mean score of the correct responses given by respondents for knowledge-related questions was 5.082. About 109 (40.4%) nurses scored more than the mean score, whereas 161 (59.6%) nurses scored less than the mean score.

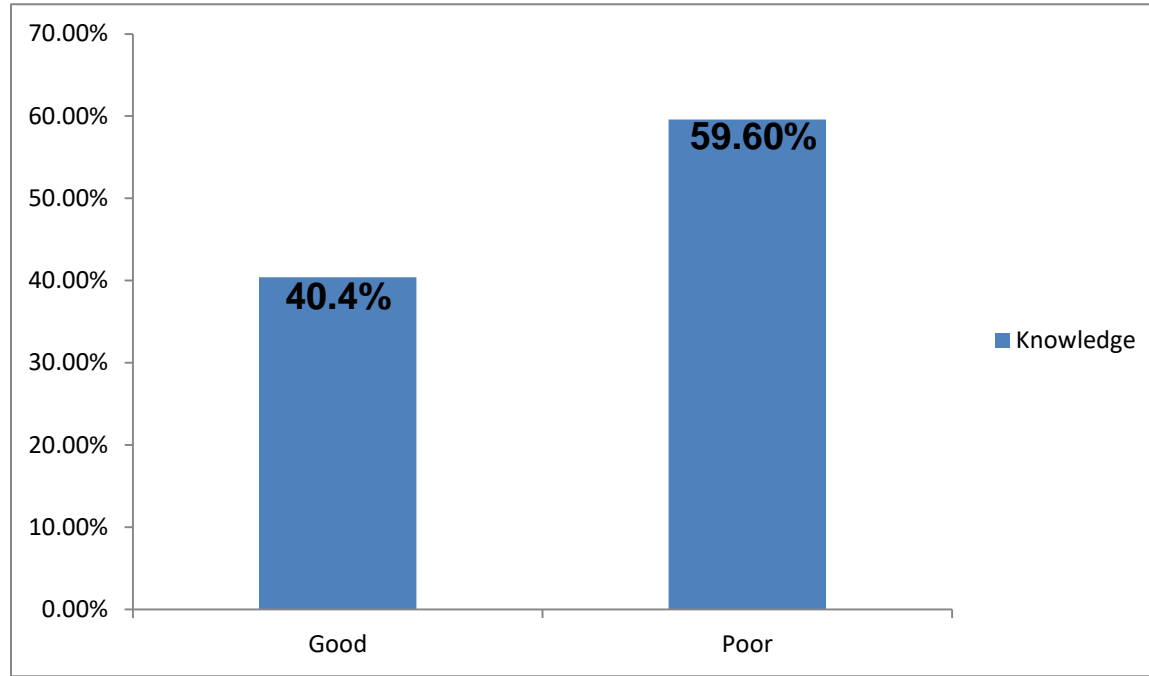


Figure 3: Knowledge of nurses working at public hospitals in Hawassa City, Ethiopia, 2023

5.3. Attitude of respondents towards fluid balance monitoring practice

The attitude of respondents towards fluid balance monitoring practice as presented in Table 3 showed that 131 (48.6%) of the respondents disagreed with the presence of many other patient care activities that are more important to attend than recording input and output every hour. Among the respondents, 141 (52.6%) agreed that too many people fill in one patient's fluid balance chart. Around half of the respondents, 139 (51.5%), agree that the nurse is the only person responsible for a correct fluid balance calculation. Nearly two-thirds of the respondents, 168 (72.2%), agree that inaccurate fluid balance calculations can pose a risk for patients. Slightly more than half of the respondents, 145 (53.7%), had a favorable attitude towards fluid balance monitoring, but 125 (46.3%) had an unfavorable attitude.

Table 3: Assessing attitude related questions of nurses towards fluid balance monitoring practice working at public hospitals in Hawassa City, Ethiopia, 2023(N=270)

Variables	Response category	Frequency	Percentage
Many other patient care activities that are more important for me to attend than recording input and output every hour	Agree	26	9.6
	Uncertain	113	41.9
	Disagree	131	48.6
Too many people fill in one patient's fluid balance chart	Agree	141	52.6
	Uncertain	48	17.4
	Disagree	81	30
Nurse is the only person responsible for a correct fluid balance calculation	Agree	139	51.5
	Uncertain	58	21.5
	Disagree	73	27.1
There is small nurse to patient ratio, and therefore it is difficult to supervise	Agree	110	40.7
	Uncertain	46	17
	Disagree	114	42
Satisfied with the design of fluid balance chart sheet	Agree	75	27.8
	Uncertain	104	38.5
	Disagree	91	33.7
Space to write the fluid numbers on the chart is adequate	Agree	121	44.8
	Uncertain	44	16.3
	Disagree	105	38.9
Final 24-hour fluid balance is calculated correctly all the time	Agree	81	34.1
	Uncertain	90	33.3
	Disagree	88	32.6
Important to guide nursing cares of patients	Agree	96	35.6
	Uncertain	23	8.5
	Disagree	151	55.9
Inaccurate fluid balance calculation can be risk for patients	Agree	168	72.2
	Uncertain	23	8.5
	Disagree	79	19.3
Recorded in too many different places	Agree	104	38.5
	Uncertain	58	21.5
	Disagree	108	40
Attitude category	Favorable	145	53.7
	Unfavorable	125	46.3

The mean score of the responses given by respondents for attitude-related items towards fluid balance monitoring practice was 29.28. About 145 (53.7%) nurses scored more than the mean score, whereas 125 (46.3%) nurses scored less than the mean score.

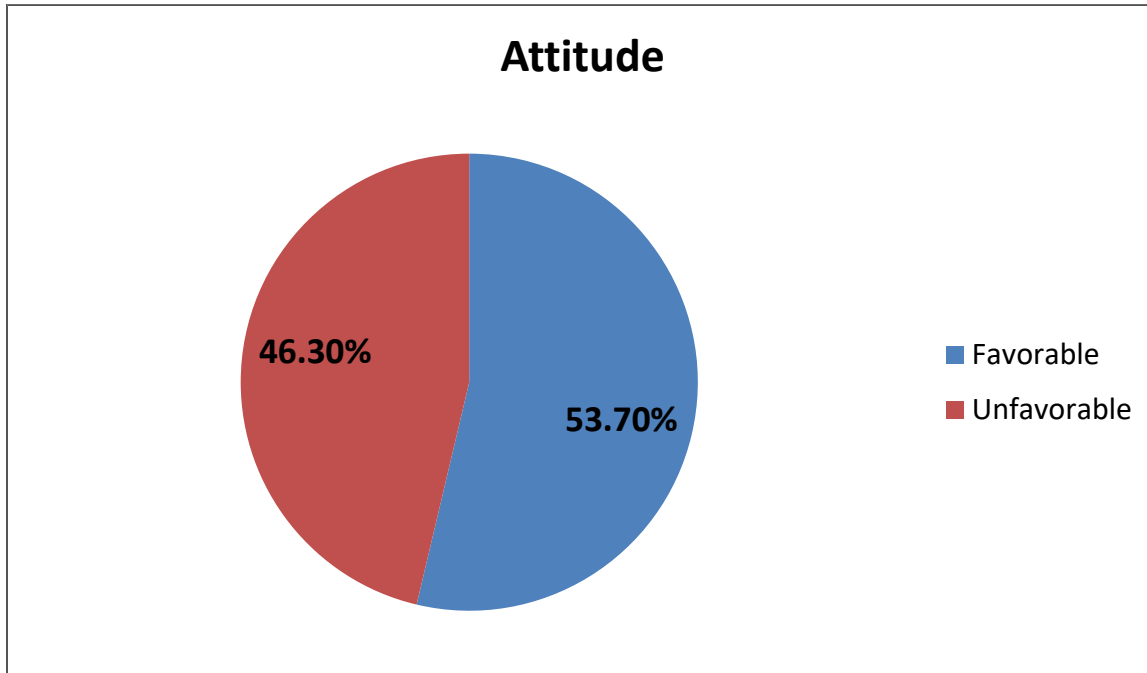


Figure 4: Attitude of nurses working at public hospitals in Hawassa City, Ethiopia, 2023

5.4. Fluid balance monitoring practice of nurses

From fifty randomly selected nurses for fluid balance monitoring practice assessment, 41 (82%) were checking the amount and type of fluid against the doctor's prescription; 36 (72%) were not documenting the prescribed fluid on the chart; 45(90%) were not documenting additives added to the fluid; and 41(82%) were documenting urine output per hour. About 43 (86%) nurses were recording the number of feeds through the nasogastric tube. Almost all nurses 49(98%) were not including IV medication volume and 0.9% normal saline flushes as input in the patient chart. The majority of nurses 47(94%) were not checking the patient's lab investigation results. Among the respondent nurses, 46 (92%) did not weigh patients daily. About 44 (88%) nurses were not documenting 24-hour fluid balance accurately.

Table 4: Assessing fluid balance monitoring practice of nurses working at public hospitals in Hawassa City, Ethiopia, 2023(N=50)

Variables	Response category	Frequency	Percentage
Check the amount and type of fluid against doctor's prescription	Perform	9	18
	Not perform	41	82
Accurately adjust the fluid flow rate	Perform	36	72
	Not perform	14	28
Document the prescribed fluid on chart	Perform	14	28
	Not perform	36	72
Document the time started and the time of end	Perform	23	46
	Not perform	27	54
Mentioning the amount of fluid infused	Perform	25	50
	Not perform	25	50
Document additives added to the fluid	Perform	45	90
	Not perform	5	10
Document urine output per hour	Perform	41	82
	Not perform	9	18
Record the amount feeds through Nasogastric tube	Perform	43	86
	Not perform	7	14
Document insensible losses especially when the patient is feverish	Perform	33	66
	Not perform	17	34
Include IV medication volume and 0.9% Normal Saline flushes as input in patient chart	Perform	1	2
	Not perform	49	98
Use measuring cup to estimate any fluid taken by mouth	Perform	2	4
	Not perform	48	96
Document the amount of drainage if it is found.	Perform	27	54
	Not perform	23	46
Check patient lab investigation results	Perform	3	6
	Not perform	47	94

Check any signs for hypervolemia	Perform	12	24
	Not perform	38	76
Assess patient for any sign of fluid deficit	Perform	15	30
	Not perform	35	70
Auscultate lung sounds	Perform	3	6
	Not perform	47	94
Weigh patient daily	Perform	4	8
	Not perform	46	92
Assess O ₂ saturation	Perform	45	90
	Not perform	5	10
Check patient hemodynamic status periodically	Perform	13	26
	Not perform	37	74
Document 24-hours fluid balance accurately	Perform	6	12
	Not perform	44	88
Practice category	Good	23	46
	Poor	27	54

The mean score for practice was 7.82. About 27 (54%) nurses scored less than the mean score, whereas 125 (46%) nurses scored more than the mean score.

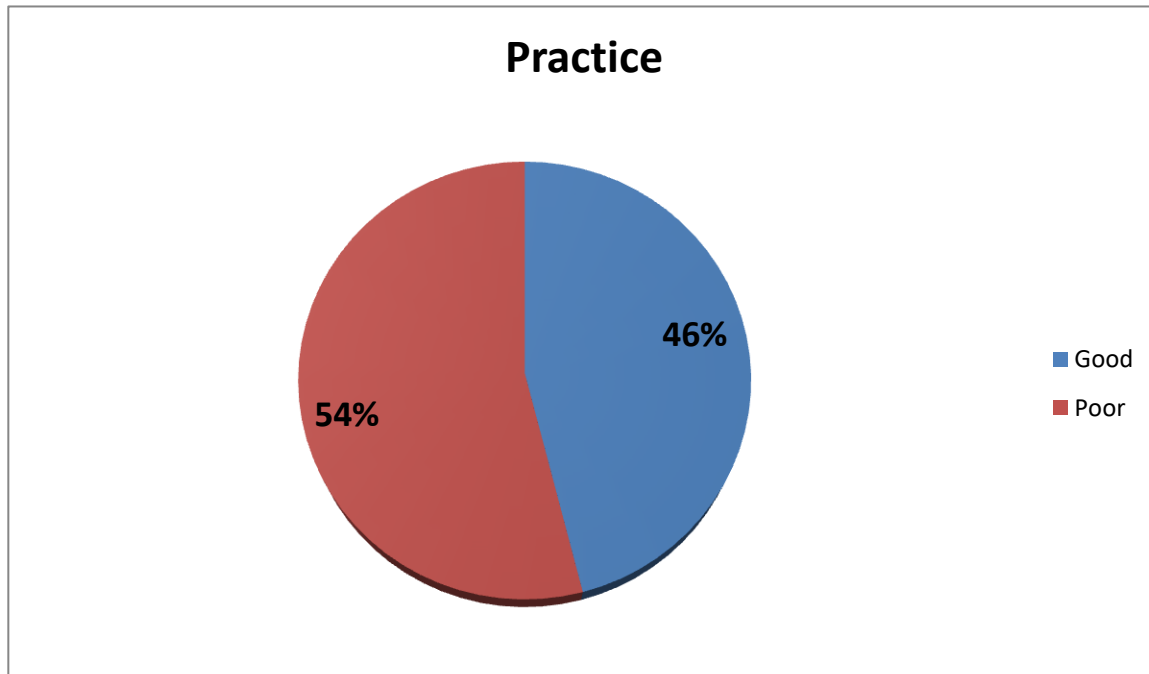


Figure 5: Practice of nurses working at public hospitals in Hawassa City, Ethiopia, 2023

5.5. Reasons for not performing fluid balance monitoring practice among nurses

This study revealed that 170 (63%) respondents were not performing fluid balance monitoring practices from the total (270) nurses. The reasons for not performing fluid balance monitoring practice were: I could not find a fluid recording sheet; lack of skills; no adequate trained staff; shortage of time; poor nursing handover system; lack of a standard of practice for fluid balance monitoring; and unsatisfied monthly income with their respective scores: 32 (11.9%), 22 (8.1%), 56 (20.1%), 22 (8.1%), 6 (2.2%), 29 (10.7%), and 3 (1.1%). About 100 (37%) nurses perform fluid balance monitoring practice as presented in the Table 5.

Table 5: Reasons for not performing fluid balance monitoring practice among nurses working at public hospitals in Hawassa City, Ethiopia, 2023(N=270)

	Responses	Frequency	Percentage
Those who were not performing	I could not find fluid recording sheet	32	11.9
	Lack of skills	22	8.1
	No adequate trained staff	56	20.1
	Shortage of time	22	8.1
	Poor nursing handover system	6	2.2
	Lack of standard of practice for fluid balance monitoring	29	10.7
	Unsatisfied monthly income	3	1.1
Those who were documenting		100	37
Total		270	100

5.6. Factors associated with the fluid balance monitoring practice of respondents

Before proceeding with the regression analysis, the assumptions of logistic regression and model fitness were checked using different methods. A total of ten variables were used for crude odds ratio analysis: age, sex, marital status, level of education attained in nursing, work experience, gross monthly salary, working department or unit, training on fluid balance monitoring practice, knowledge category, and attitude category. Out of these ten variables, five variables with p-values <0.25 in bivariate logistic regression were entered into multivariable analysis. Sex and knowledge were statistically significantly associated with fluid balance monitoring practice after checking for model fitness using different methods and controlling for confounders in multivariable analysis.

According to the findings of this study, the performance of female nurses in fluid balance monitoring is 85% less than that of male nurses (AOR = 0.153: 0.024, 0.981, p-value = 0.048), and nurses with good knowledge had 19.029 times better practice than nurses with poor knowledge (AOR = 19.029: 3.053, 118.601, p-value = 0.002) as presented in the Table 6.

Table 6: Bivariate and multivariate logistic regression for factors associated with fluid balance monitoring practice among nurses working at public hospitals in Hawassa City, Ethiopia, 2023 (N = 50)

Variables		Fluid balance monitoring practice		COR(95% CI)	AOR(95% CI)	P-value
		Good	Poor			
Age	<30	2(8.7%)	7(25.9%)	3.675(0.680,19.848)	1.992(0.204,19.411)	0.553
	≥30	21(91.3%)	20(74.1%)			
Sex	Male	19(82.6%)	14(51.9%)	0.0227(0.061,0.061)	0.153(0.024,0.981)	0.048*
	Female	4(17.4%)	13(48.1%)			
Marital status	Married	15(65.2%)	18(66.7%)	1.067(0.330,3.448)		
	Single	8(34.8)	9(33.3%)			
Level of education	BSc in Comprehensive Nursing	14(60.9%)	21(77.8%)	1.796(0.635,5.082)		
	BSc in Emergency and critical care nursing	8(34.8%)	5(18.5%)			
	BSc in Pediatrics and Child Health nursing	1(4.3%)	1(3.7%)			
Work experience	<5 years	5(21.7%)	10(37.0%)	2.118(0.600,7.478)	0.715(0.090,5.684)	0.751
	≥5 years	18(78.3%)	17(63.0%)			
Gross monthly salary	<7000	1(4.3%)	2(7.4%)	1.760(0.149,20.764)		
	≥7000	22(95.7%)	25(92.6%)			
Working department/unit	Adult EOPD	8(34.8%)	10(37.0%)	1.111(0.060,20.48)		
	ICU	14(60.9%)	12(44.4%)			
	NICU	1(4.3%)	5(18.5%)			
Received training	Yes	9(39.1%)	8(29.6%)	0.655(0.284,3.583)		
	No	14(60.9%)	19(70.4%)			
Knowledge category	Good	2(8.7%)	16(59.3%)	15.273(2.960,78.814)	19.029(3.053,118.601)	0.002*
	Poor	21(91.3%)	11(40.7%)			
Attitude category	Favorable	10(43.5%)	19(70.4%)	3.087(0.961,9.919)	3.078(0.676,14.015)	0.146
	Unfavorable	13(56.5%)	8(29.6%)			

Note: *Statistically significant at p-value <0.05, 95%CI

CHAPTER SIX

DISCUSSION

In the current study, 67% of the total nurses did not perform fluid balance monitoring. From 50 nurses assessed for fluid balance monitoring practice through observation, 54% scored poor for fluid balance monitoring practice, and 46% scored good for fluid balance monitoring practice. This result is lower than the result of a cross-sectional study done at Maternity and Children Hospital, Makka City, Saudi Arabia, on 66 nurses, which showed that 93.9% of nurses calculated and documented 24-hour fluid balance correctly (Sayed, 2022). Unlike this, the study done in Addis Abeba revealed that 56.3% of nurses who were working in the ICU of federally administered governmental hospitals scored good performance, whereas 43.7% scored poor performance based on overall practice done through observation (Mengistu, 2020). The variation might be due to the adequate availability of fluid balance monitoring equipment, high awareness among nurses, the provision of in-service training, the presence of adequately trained staff, workplace supervision, and a strong health management system.

According to the findings of this study, sex was associated negatively with the fluid balance monitoring practice of nurses (AOR = 0.153:0.024, 0.981, p-value = 0.048). Findings from this study revealed that the nurses' knowledge score and the level of practice are statistically significantly associated, and nurses who scored above the mean score of knowledge-related multiple choice questions performed 19.02 times better than nurses who scored below the mean score of knowledge (AOR = 19.029: 3.053, 118.601, p = 0.002).

Thus, knowledge was found to be a predictor of the fluid balance monitoring practice of nurses. This finding is in line with the findings of the study, which showed a statistically significant relationship between nurses' knowledge score and level of practice regarding body fluid balance assessment post-intervention (Abd Elalem and Fouad, 2018). Also, this result is similar to the result of the study done in Addis Abeba to examine knowledge, attitude, practice, and associated factors towards fluid balance monitoring among ICU nurses working in federally administered hospitals, which showed that there was a statistically significant association between nurses' knowledge score and level of practice regarding body fluid balance monitoring (OR = 7.33, CI 3.57–15.062, p < 0.01) (Mengistu, 2020).

CHAPTER SEVEN

STRENGTH AND LIMITATIONS OF THE STUDY

7.1. Strength of the study

- Using multivariable analysis to control the effect of possible confounders.
- Using MSc and BSc nurses for data collection.

7.2. Limitations of the study

- Resource scarcity
- A small number of nurses were assessed for fluid balance monitoring practice due to the impracticability of fluid balance monitoring practice by nurses in many inpatient departments in public hospitals in Hawassa City.

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATION

8.1. Conclusion

More than half of the studied nurses scored below the mean score for correct responses related to fluid balance monitoring practice questions. Thus, nurses' fluid balance monitoring practice was unsatisfactory. In fluid balance monitoring, the performance of female nurses is 85% less than that of male nurses. The knowledge of nurses was found to be a predictor of fluid balance monitoring practice. Nurses who scored below the mean score for correct responses to knowledge-related questions performed fluid balance monitoring practice poorly. Thus, nurses' poor knowledge regarding fluid balance monitoring had a negative impact on their fluid balance monitoring practice.

8.2. Recommendation

Based on the findings of this study the following recommendations are forwarded to concerned bodies.

❖ **For hospitals**

- Nurses' in-service and ongoing professional development training on the knowledge and practice of fluid balance monitoring has to be strengthened.

➤ **For upcoming researchers**

- Prospective cohort study is strongly recommended.
- Do further research in settings with poor resource.

REFERENCES

- Abd El-Salamsheta, H. & Mahmoud, M. H. 2018. Effectiveness of structured educational program on knowledge and practice among nurses regarding body fluid balance assessment for critically ill patients. *IOSR J Nurs Health Sci*, 7, 74-83.
- Abd Elalem, S. & Fouad, N. 2018. Effect of an instruction intervention about body fluid balance assessment on knowledge and practice among nurses in Intensive Care Unit. *International Journal of Novel Research in Healthcare and Nursing*, 5, 94-105.
- Andarge, D. B., Anticho, T. L., Jara, G. M. & Ali, M. M. 2021. Prevalence of Mycobacterium tuberculosis infection and rifampicin resistance among presumptive tuberculosis cases visiting tuberculosis clinic of Adare General Hospital, Southern Ethiopia. *SAGE open medicine*, 9, 20503121211045541.
- Asfour, H. I. 2016. Fluid balance monitoring accuracy in intensive care units. *IOSR J Nur Heal Sci*, 5, 53-62.
- Balakumar, V., Murugan, R., Sileanu, F. E., Palevsky, P., Clermont, G. & Kellum, J. A. 2017. Both positive and negative fluid balance may be associated with reduced long-term survival in the critically ill. *Critical care medicine*, 45, e749-e757.
- Bedry, T. & Tadele, H. 2020. Pattern and outcome of pediatric traumatic brain injury at hawassa university comprehensive specialized hospital, southern Ethiopia: observational cross-sectional study. *Emergency medicine international*, 2020.
- Bird, F., Campbell, T. & Freebairn, R. 2021. Estimates of fluid balance and insensible loss in the critically ill: A cohort study in a non-metropolitan intensive care unit. *Critical Care & Shock*, 24.
- Diacon, A. 2012. Fluid balance monitoring in critically ill patients.
- Diacon, A. & Bell, J. 2014. Investigating the recording and accuracy of fluid balance monitoring in critically ill patients. *Southern African Journal of Critical Care (Online)*, 30, 55-57.
- Elizabeth Thompson, M. B., Abigail Bowers, Grace Walker And Carlo Prina 2020. Quality improvement project: identifying the barriers to accurate assessment and documentation of fluid status monitoring
- Elliott, M. & Coventry, A. 2012. Critical care: the eight vital signs of patient monitoring. *British Journal of Nursing*, 21, 621-625.
- Eveline Janine Anna Wieggers, H. F. L., Jilske Antonia Huijben, David James Cooper, Giuseppe Citerio, Shirin Frisvold, Raimund Helbok, , Andrew Ian Ramsay Maas, D. K. M., Elizabeth Madeleine Moore, Nino Stocchetti, Diederik Willem Dippel, Ewout Willem Steyerberg, & Mathieu Van Der Jagt, O. B. O. T. C.-T. A. O.-T. C. G. 2021. Fluid balance and outcome in critically ill patients with traumatic brain injury (CENTER-TBI and OzENTER-TBI): a prospective, multicentre, comparative effectiveness study. *Lancet Neurol* ;, 627-38.

- Gonzalez, F. & Vincent, F. 2011. The fluid balance in the critically ill patients: what are we talking about? *Minerva Anestesiologica*, 77, 766-767.
- Herbert, L., Elsayed, I. & Mcdougall, M. 2016. Fluid and Electrolyte Balance in the Intensive Care Unit—Trickle or Flood.
- Johnson, P. 2016. Practical Assessment of Volume Status in Daily Practice. *Topics in companion animal medicine*, 31, 86-93.
- Kang, N.-Y. A., Sukhee 2016. Nurses' Perception and Practice of Fluid Intake and Output Measurement. 23.
- Kissoon, N. R., Mandrekar, J. N., Fugate, J. E., Lanzino, G., Wijdicks, E. F. & Rabinstein, A. A. 2015. Positive fluid balance is associated with poor outcomes in subarachnoid hemorrhage. *Journal of Stroke and Cerebrovascular Diseases*, 24, 2245-2251.
- Mansour, H. E. 2019. Developing Nursing Standards for Maintaining Fluid and Electrolyte Balance for Critically Ill Patients in Intensive Care Units. *Journal of intensive and critical care*, 5, 4.
- Mechal, T., Hussen, S. & Desta, M. 2021. Bacterial profile, antibiotic susceptibility pattern and associated factors among patients attending adult OPD at Hawassa University Comprehensive Specialized Hospital, Hawassa, Ethiopia. *Infection and Drug Resistance*, 99-110.
- Mengistu, W. 2020. Assessment of knowledge, attitude, practice and associated factors towards fluid balance monitoring among nurses working in adult ICU of federally administered government hospitals, Addis Ababa, Ethiopia.
- Messmer, A. S., Zingg, C., Müller, M., Gerber, J. L., Schefold, J. C. & Pfortmueller, C. A. 2020. Fluid overload and mortality in adult critical care patients—a systematic review and meta-analysis of observational studies. *Critical care medicine*, 48, 1862-1870.
- Mogileswari, P. & Ruth, M. 2016. Knowledge and practice regarding fluid and electrolyte replacement therapy for patient with burns. *International Journal of Multidisciplinary Research and Development*, 3, 217-20.
- Mohamed, M. A., Mohammed, I. R. & Taha, S. H. 2018. Effect of Educational Protocol Regarding Accurate Monitoring Fluid Balance on Critical Care Nurses' Knowledge and Practice. *Minia Scientific Nursing Journal*, 4, 76-82.
- Mwila, C. 2016. Factors associated with documentation of fluid intake and output in post-operative patients at Mansa General Hospital. University of Zambia.
- Pittard, M., Huang, S., Mclean, A. & Orde, S. 2017. Association of positive fluid balance and mortality in sepsis and septic shock in an Australian cohort. *Anaesthesia and Intensive Care*, 45, 737-743.
- Sayed, H. I. E., Aly, A. A., Mahmoud, A., & Arcipal, L. 2022. Knowledge and perception of nurses regarding fluid and electrolyte balance in intensive care units. *International Journal of Health Sciences*, 6, 10894–10909.
- Scales, K. & Pilsworth, J. 2008. The importance of fluid balance in clinical practice. *Nursing Standard (through 2013)*, 22, 50.

- Schneider, A. G., Baldwin, I., Freitag, E., Glassford, N. & Bellomo, R. 2012. Estimation of fluid status changes in critically ill patients: fluid balance chart or electronic bed weight? *Journal of critical care*, 27, 745. e7-745. e12.
- Shumaila Aslam L, M. A., Robina Kousar, Ali Waqas, And Syed Amir Gilani 2017. 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*, 5, 208-215
- Simpson, D. & McIntosh, R. 2021. Measuring and monitoring fluid balance. *British Journal of Nursing*, 30, 706-710.
- Sobeh, H. M. A. H. P. E.-S. E. E.-S. P. S. Y. M. D. D. E. T. S. 2021. Assessment of nurses' knowledge and practice regarding fluids and electrolyte imbalance in critical care units. . *Port Said Scientific Journal of Nursing*, 8.
- Taylor C., L. C., Lynn, P & Lemone, P. 2015. *Fundamentals of nursing*. Lippincott. 8th ed, ed.
- Thompson, E., Batacharyya, M., Bowers, A., Walker, G. & Prina, C. 2020. Quality improvement project: identifying the barriers to accurate assessment and documentation of fluid status monitoring. *Clinical Medicine*, 20, s76.
- Weheda, S., Mohammed, I. & El Sayed, I. 2020. Effect of Safe Hydration Management Educational Program on Nurses' Performance and Patients' Outcomes. *Assiut Scientific Nursing Journal* <http://asnj. Journals. ekb. eg>.
- Welch, K. 2010. Fluid balance. *Learning Disability Practice*, 13.

Annex I: English Version Participant Information Sheet and Informed Voluntary Consent for Health Professionals.

My name is_____. I am working as a data collector for a study being conducted in this facility by Mr. Eyob Wonte who is MSc student in Hawassa University in Emergency and Critical Care Nursing. I kindly request you to lend me your attention to explain you about the study and your institution being selected as the study setting.

The Study Title: Fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa city, southern Ethiopia, 2023. **Purpose of the study:** This study aims to assess fluid balance monitoring practice and predictors among nurses working in public hospitals in Hawassa city, southern Ethiopia, 2023. **Confidentiality:** All information taken from you will be kept confidential and won't be accessible to any third party; your identifiers like 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 practice of nurses regarding fluid balance monitoring.

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 and associated factors regarding fluid balance monitoring without confusion. In addition, I hope that you will be participating in this study since your views are very important.

Contact address: If you have any questions about the study, the procedure or anything else related to this study, please contact through the following addresses: Telephone.....+251937320466/+251707509269; Email: eyobwonte@gmail.com

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 “√” mark on the option you have.

Part one: Scio-Demographic data of nurses working at public hospitals in Hawassa City, Ethiopia, 2023

S.No	Questions	Response categories	Remark
101	Age in completed years	
102	Sex	1. Male 2. Female	
103	Marital status	1. Married 2. Single 3. Divorced 4. Widowed	
104	What is the highest level of education you have attained in nursing?	1. Diploma in Clinical Nurse 2. Diploma in Public Health Nursing 3. BSc in Comprehensive Nursing 4. BSc in Emergency and critical care nursing 5. BSc in Pediatrics and Child Health nursing 6. BSc in surgical nursing 7. BSc in Medical nursing 8. MSc in Emergency and critical care nursing 8. MSc in Adult Health nursing 9. MSc in Pediatrics and Child Health nursing 10. Please, specify if other nursing specialty.....	
105	How long have you had work experience in nursing care?	1Months Or 2years andmonths	
106	Gross monthly salaryETB	
107	Working department/unit	1.....department Or 2unit	

Part two: Assessing of Knowledge of fluid balance monitoring practice and predictors among nurses working at public hospitals in Hawassa City, Ethiopia, 2023.

201. When does fluid balance exist?

A. When the amount of intake is greater than the amount of output B. When the amount of output is greater than the amount of intake C. When the difference between intake and output is zero D. When the difference between intake and output is slightly different from zero

202. Which of the following is expected urine output in average adult patient?

A. 50ml/kg/hour B. 0.5ml/kg/hour C. 20ml/kg/hour D. 5ml/kg/hour

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

A. 500-1000ml B. 1000-1500ml C. 1500-2000ml D. 2000-2500ml

204. Clinical signs most likely to occur in the state of hypervolemia are:

A. Dyspnea, tachypnea, tachycardia B. Arrhythmia, dyspnea, desaturation C. Anuria, thirst, hypertension D. Hypertension, edema, petechial

205. What percentage of incorrect fluid balance calculation do you consider as acceptable when you are managing critically ill patients?

A. 0-5%, in this case 0-100 ml B. 5-10%, in this case 100 ml or more, less than 200 ml
C. 10-25%, in this case 200 ml or more, less than 500 ml D. >25%, in this case 500 ml or more

206. Does fluid balance include blood products?

A. Yes B. No C. Unsure D. depends on unit policy

207. Does input fluid include fluid given with drug?

A. Yes B. No C. Uncertain D. depends on unit policy

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

A. Call the doctor B. Check if the urinary catheter is free flowing
C. Remove the urinary catheter D. Increase the infusion rate

209. Among these three vital signs which one usually used as part of assessing your patient's fluid balance assessment?

- A. Temperature, limb movement, heart rate B. Fluid intake, urine production, nasogastric drainage C. Urine production, GCS, respiratory rate D. Blood pressure, pulmonary arterial wedge pressure, bowel activity

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

- A. Weight, central venous pressure, peripheral pulses B. Electrolytes, edema, crackles
 C. Vancomycin level, airway pressure, pupil reaction D. Jugular vein distension, Specific gravity changes, oxygen saturation

Part three: Assessing attitude related questions of nurses working at public hospitals in Hawassa City, Ethiopia, 2023

S.No	Questions	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree
301	There are many other patient care activities that are more important for me to attend than recording input and output every hour					
302	There are too many people who fill in one patient's fluid balance chart					
303	The nurse is the only person responsible for a correct fluid balance calculation					
304	There is small nurse to patient ratio, and therefore it is difficult to supervise all the fluid balance activities					
305	I am satisfied with the design of fluid balance chart sheet. It is straightforward to complete					
306	The space to write the fluid numbers on the chart is adequate					
307	The final 24-hour fluid balance is calculated correctly all the time					
308	Fluid balance assessment is important to guide nursing cares of patients					
309	Inaccurate fluid balance calculation can be risk for patients					
310	Fluid balance monitoring is recorded in too many different places in nursing care observation and patient records					

Part four: Associated factors of fluid balance monitoring among nurses working at public hospitals in Hawassa City, Ethiopia, 2023.

S.No	Questions	Response categories	Remark
401	Have you ever received on-the-job training or any training package that included knowledge, attitude, and skills for fluid balance monitoring?	1. Yes 2. No	If no go to Q3
402	If yes for question 1, when did you receive training?years ago,months ago	
403	Do you perform fluid balance monitoring for all patients who need fluid balance monitoring?	1. Yes 2. No	If yes go to Q5
404	If “No” for Q3, What are the reasons for not performing fluid balance monitoring for all patients?(more than one answer is possible)	1. I could not find fluid recording sheet 2. Lack of skills 3. No adequate trained staff 4. Shortage of time 5. Poor nursing handover system 6. Lack of standard of practice for fluid balance monitoring 7. Unsatisfied monthly income 8. Workload 9. If others, please specify	


Part five: Practice of nurses working at public hospitals in Hawassa City, Ethiopia, 2023.

Observational checklist

S.No	Checklist	Yes	No
501	Check the amount and type of fluid against doctor's prescription		
502	Accurately adjust the fluid flow rate		
503	Document the prescribed fluid on chart		
504	Document the time started and the time of end		
505	Mentioning the amount of fluid infused		
506	Document additives added to the fluid		
507	Document urine output per hour		
508	Record the amount feeds through Nasogastric tube		
509	Document insensible losses especially when the patient is feverish		
510	Include IV medication volume and 0.9% Normal Saline flushes as input in patient chart		
511	Use measuring cup to estimate any fluid taken by mouth		
512	Document the amount of drainage if it is found.		
513	Check patient lab investigation results		
514	Check any signs for hypervolemia		
515	Assess patient for any sign of fluid deficit		
516	Auscultate lung sounds		
517	Weigh patient daily		
518	Assess O2 saturation		
519	Check patient hemodynamic status periodically		
520	Document 24-hours fluid balance accurately		

Annex II: Letter of ethical clearance from Institutional Review Board of Hawassa University College of Medicine and Health Science

ሀዋሳ ዩኒቨርሲቲ
 በከምናና ጤና ሳይንስ ኮሌጅ
 የምርምር ስነ-ምግባር ገምገሚያ ቦርድ



HAWASSA UNIVERSITY
 COLLEGE OF MEDICINE AND
 HEALTH SCIENCES
 Institutional Review Board

Ref. No: IRB/300/15
 Date: 25/04/2023

Name of Researcher(s): **Eyob Wonte, Thomas Fako (MSC.), Alemneh Kabeta (PhD, asst. prof.)**

Topic of Proposal: *Fluid balance monitoring practice and predictors among nurses working in public hospitals in Hawassa city, southern Ethiopia, 2023*

Dear researcher(s),
 The Institutional Review Board (IRB) at the College of Medicine and Health Sciences of Hawassa University has reviewed the aforementioned research protocol with special emphasis on the following points:

1. Are all principles considered?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
1.1. Respect for persons:		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
1.2. Beneficence:		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
1.3. Justice:		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
2. Are the objectives of the study ethically achievable?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
3. Are the proposed research methods ethically sound?		Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>

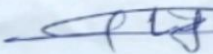
Based on the aforementioned ethical assessment, the IRB has:

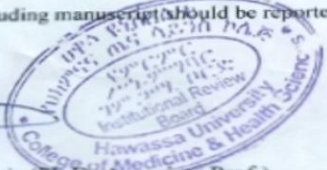
A. Approved the proposal for implementation	<input checked="" type="checkbox"/> Approval period - 25 April 2023 to 24 April 2024
B. Conditionally Approved	<input type="checkbox"/> Element Approved: Protocol Version No. 1
C. Not Approved	<input type="checkbox"/> Follow up report expected in 6 months

Obligation of the PI:

1. Should comply with the standard international and national scientific and ethical guidelines
2. All amendment and changes made in protocol and consent form needs IRB approval
3. The PI should report SAE within 3 days of the event
4. End of study, including manuscript should be reported to the IRB

Yours faithfully,





Dr. Embialle Mengistie (Ph.D. Associate Prof.)
 Chairperson, Institutional Review Board

☎: + 046 8209290 Website:

Fax: + 046 2208755 ✉ 1560 CMHS, Hawassa-Ethiopia