ADDIS ABABA UNIVERSITY, HEALTH SCIENCES COLLEGE, SURGERY DEPARTMENT, UROLOGY DIVISION, ADDIS ABABA, ETHIOPIA

KNOWLEDGE, ATTITUDE, AND PRACTICE OF NURSES ON THE USE OF GLUTARALDEHYDE IN UROLOGY DEPARTMENTS AT THREE HOSPITALS, ADDIS ABABA, ETHIOPIA, 2025

A RESEARCH THESIS TO BE SUBMITTED TO SURGERY DEPARTMENT, UROLOGY DIVISION, COLLEGE OF HEALTH SCIENCES, ADDIS ABABA UNIVERSITY; IN PARTIAL FULFILLMENT OF THE SPECIALITY CIRTEFICATE IN UROLOGY.

PRINCIPAL INVESTIGATOR: TSIYON NIGUSIE (MD, UROLOGY RESIDENT)

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Name of Dean, College Signature Date

STATEMENT OF THE AUTHOR

I confirm by my signature below that this research is my own original work. From planning and collecting data to the final analysis and write up , I have strictly followed all ethical guidelines. All the source I used has been appropriately cited and credited.

I am submitting this document to the Tikur Anbessa College of Health Sciences at Addis Ababa University to fulfill the requirements for my specialty degree in Urology. Finally, I declare that this thesis has not been submitted anywhere else for any other degree, diploma, or certificate.

Name: _____

Signature: _____ Date: _____

Program: Residency in Urology, Tikur Anbessa College of Health Sciences

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List of abbreviations

GA: Glutaraldehyde

HAI: Healthcare-Associated Infection

HLD: High-Level Disinfection

KAP: Knowledge, Attitude, and Practice

PPE: Personal Protective Equipment

RKI: Robert Koch-Institut

MEC: Minimum effective concentration

SPSS: Statistical Package for the Social Sciences

SOP: Standard Operating Procedures

TASH: Tikur Anbessa Specialized Hospital

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ABSTRACT

Background: Glutaraldehyde is a widely used high-level disinfectant for reprocessing heat-sensitive urological instruments such as endoscopes. Although effective when used properly, improper handling or inadequate knowledge of reprocessing protocols can expose patients to healthcare-associated infections and staff to chemical hazards. Despite its widespread use in Ethiopian hospitals, there is limited data on nurses' knowledge, attitude, and practice regarding glutaraldehyde use in urology departments.

Objective: To assess the knowledge, attitude, and practice of nurses on the safe and effective use of glutaraldehyde for urological instrument reprocessing in three tertiary hospitals in Addis Ababa—Tikur Anbessa Specialized Hospital, Yekatit 12 Hospital Medical College, and Minilik II Comprehensive Specialized Hospital.

Methods: A cross-sectional study conducted from September 1–30, 2025, by including all nurses working in the urology departments of the three hospitals. Data collected using a structured, self-administered questionnaire covering sociodemographic information, knowledge, attitude, and practice components. A descriptive analysis was used to report the percentages and frequencies. The mean knowledge, attitude, and practice scores were analyzed using an Independent t-test, ANOVA, and Pearson's correlation tests.

Results: A total of 42 urology department nurses participated in the survey. Half of the nurses exhibited average knowledge and only a minority(14.3%) had adequate knowledge.78.6% of nurses demonstrated a strong Positive Attitude toward safety. However, this attitude did not translate into safe practice, as 46.3% of participants demonstrated Inadequate Practice, and only 2.4% achieved an Adequate Practice score. A significant finding was the perceived lack of institutional support: 58.5% strongly disagreed that their workplace provides sufficient Personal Protective Equipment (PPE) and training. Significant difference in the mean overall kAP score is found across the nurses highest professional qualification ($p=0.036$) and status of nurses on receiving formal training on glutaraldehyde use ($p=0.007$). Additionally, a significant positive correlation between knowledge-attitude ($r=0.238$, $p<0.05$) was seen. However a weak and non significant correlation between knowledge-practice ($r=0.03$, $p>0.05$), and attitude-practice ($r=0.02$, $p>0.05$) was observed.

Conclusion: Despite a generally positive attitude and a portion of nurses achieving adequate knowledge, the concerning finding of inadequate practice and the strong perception of lack of resource, adequate training and written, facility-specific standard operating procedures brings a critical challenge. Urgent, interventions are needed to prevent patient infection risk and bring occupational health.

Keywords: Glutaraldehyde, High Level Disinfection, Endoscope Reprocessing, Infection Prevention, Occupational Safety

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CHAPTER 1. INTRODUCTION

1.1 Background of the study

Urology is a surgical specialty that depends on complex and reusable endoscopic and laparoscopic instruments. Instruments such as flexible cystoscopes are classified as semi-critical devices, as they come into contact with mucous membranes and require, at minimum, high-level disinfection (HLD) between procedures to prevent the transmission of infections.

Glutaraldehyde is a high-level disinfectant especially used for the reprocessing of heat-sensitive urological instruments. When used appropriately, GA is highly effective against bacteria, viruses, fungi, and mycobacteria. The main thing while using glutaraldehyde is that the equipment should be thoroughly cleaned before disinfecting it. If any blood or mucus is left behind, it can make it ineffective, which leads to cross-contamination.

Besides, Glutaraldehyde is an irritant chemical for the exposed staffs. It has negative effect on skin, eyes, and lungs, and has been known to cause long-term health issues like asthma or skin rashes (dermatitis). Because of these risks, the nurses knowledge, attitude, and practice regarding glutaraldehyde is important.

1.2 Statement of the problem

When glutaraldehyde is used improperly, disinfection become ineffective, which creates a serious risk of spreading infections from one patient to another. various outbreaks have been documented and has been associated to failure to follow disinfection guidelines properly.

While studies in other settings have shown concerning gaps in how these instruments are handled, the situation in Ethiopia is not known. Even though glutaraldehyde is used every day at major hospitals like TASH, Yekatit 12, and Minilik II, no data has been published to assess the knowledge, attitudes, or actual practices of the urology nurses. It is currently unknown to what extent patients are being protected from infection or how well staff members are safe during the exposure to GA. This lack of evidence should be addressed to ensure both quality of care and the staff safety.

1.3 Justification of this study

Research from several countries has shown significant gaps in how healthcare workers understand and use glutaraldehyde. This deficiency are known to affect negatively both the safety of patients and the well-being of staff. Within Ethiopia, no study has yet been published to assess the knowledge, attitudes, and practices (KAP) of nurses regarding the reprocessing of urology instruments using glutaraldehyde. By identifying these

gaps, the findings of this study will be used to develop targeted interventions, ensuring that disinfection practices become safe and effective.

CHAPTER 2. LITERATURE REVIEW

The sterilization and disinfection of heat-sensitive instruments used in urology are considered essential for preventing infections within healthcare settings (1,2). This process is known as complex which needs strict adherence to standard guidelines to ensure the safety of both patients and healthcare workers (2,3). Glutaraldehyde has been used at many places as high-level disinfectant for urological equipment reprocessing because of its numerous advantages. It is highly effective when used correctly.Additionally it is compatible with materials prone to damage during re processing which has lens or made of plastics (4,5,6). An early evaluation demonstrated that immersion in 2% activated glutaraldehyde for just two minutes was effective against vegetative bacteria, Mycobacterium tuberculosis, fungi, and viruses, including HIV and Hepatitis B, typically within 10 minutes of contact although it need more exposure time to kill spores of Bacillus, Clostridium species and mycobacteria. After being activated, it should be used for 14 days. (6,7,8,9).

Effective instrument reprocessing is a multi-step process, with each stage being essential for the final outcome. The entire chain of decontamination begins with thorough manual cleaning, which has been identified as a vital factor for the overall success of endoscope reprocessing (10,11)

As Martiny et al. (2004) emphasize, cleaning is the most important step in the entire reprocessing cycle (12). It is well known that organic materials such as blood, serum, and mucus can interfere with the effectiveness of disinfectants if they are left on instrument surfaces. This organic soil can act as a physical barrier that prevents microorganisms from the chemical agent, or it may react with the glutaraldehyde itself, which reduces the effective concentration. This principle is very fundamental and any failure to clean an instrument properly is seen as making the subsequent disinfection or sterilization unreliable, regardless of which chemical is used (13).

Research has shown that a combination of thorough cleaning and sufficient exposure time to glutaraldehyde is prerequisite for the effective disinfection of fiberoptic endoscopes (14). However, the reprocessing cycle is not considered complete after only chemical immersion. The steps following HLD are considered equally important. Instruments must be thoroughly rinsed with sterile or filtered water to remove toxic chemical residues that could harm a patient. This should followed by drying, often using forced air, which is a critical step for preventing the growth of waterborne microorganisms during storage (10,13,14). Currently, the proper drying and storage of flexible endoscopes are accepted as areas of growing concern, as any moisture left behind can create a breeding ground for bacteria (10).

Significant gaps between attitude and practice in endoscope reprocessing have been found by many studies, despite the existence of guidelines. These inconsistent practices are known to increase the risk of infection transmission, and incorrectly reprocessed endoscopes are documented sources of exposure in healthcare settings (15). For example, a comprehensive study in Brazil by Barbosa et al. (2010) found failures at

every stage including Pre-washing, failure of brushing of internal channels, failure to totally immerse in glutaraldehyde.

Similar issues have been found in other areas of the world. In rural India, lack of essential equipment was found as barrier (14). In Frankfurt, Germany, inspections revealed that only two out of eight private practices were reprocessing flexible cystoscopes according to national guidelines (17). Furthermore, in India, Mycobacterium tuberculosis was isolated from port-site infections following laparoscopic surgeries, a contamination believed to have occurred during the reprocessing of reusable instruments (18).

The use of glutaraldehyde is also a risk to the healthcare workers who handle it. It is classified as an irritant, and exposure is associated with various adverse health effects. According to a review by Takigawa and Endo (2006):

Skin irritation and allergic contact dermatitis are commonly reported, with severity depending on contact duration and chemical concentration.

The inhalation of vapor is a known cause of occupational asthma, chronic bronchitis, and nasal irritation. Eye irritation is also frequently reported among medical staff (19).

A survey of endoscopy nurses in the UK found a significant association between glutaraldehyde concentrations and work-related respiratory symptoms (20). Symptoms have been found in individuals even when exposure levels were below the recommended limit. These findings emphasizes the need of strict adherence to safety protocols, including the use of proper ventilation and appropriate Personal Protective Equipment (PPE) such as nitrile gloves, gowns, and eye protection (19,20).

CHAPTER 3. OBJECTIVES

3.1. General objective

To assess the knowledge, attitude, and practice regarding the safe and effective use of glutaraldehyde in re-processing of urological instruments among nurses in the urology departments of TASH, Yekatit 12, and Minilik II hospitals.

3.2. Specific objective

To determine nurses' knowledge regarding glutaraldehyde's properties for high-level disinfection, correct processing protocols, and its associated patient and occupational health risks.

To assess nurses' attitudes towards the importance of strict adherence to disinfection protocols to prevent patient infection transmission.

To evaluate nurses' self-reported practices in handling glutaraldehyde to ensure both instrument sterility and personal safety.

To identify factors (e.g., years of experience, prior training, educational level) associated with the knowledge, attitude, and practice scores of the nurses.

CHAPTER 4. REASERCH METHODOLOGY

4.1. Research question

What is the knowledge, attitude, and practice of nurses regarding the use of glutaraldehyde for re-processing of urological instruments in urology departments of TASH, Yekatit 12, and Minilik II hospitals?

4.2. Study area and period

This study is conducted in the urology departments of Tikur Anbessa Specialized Hospital (TASH), Yekatit 12 Hospital Medical College, and Minilik II Comprehensive Specialized Hospital in Addis Ababa, Ethiopia from September 1 to 30, 2025.

4.3. Study design

A cross-sectional study design is used.

4.4. Source population

All nurses working in the urology departments of Tikur Anbessa Specialized Hospital, Yekatit 12 Hospital Medical College, and Minilik II Comprehensive Specialized Hospital.

4.5. Study population

All nurses working in the specified urology departments during the data collection period who fulfill the inclusion criteria.

4.6. Study unit

Each individual nurse participating in the study.

4.7. Sample size calculation

The sample size will be calculated using the single population proportion formula:

$N=Z2pq/d\ 2$

where:

Z = standard normal variable at 95% Confidence interval = 1.96

p = Since there are no previous similar studies in Ethiopia, a proportion of 0.5 will be used to obtain the maximum sample size.

$q=1-p=0.5$ d = marginal error at

5% = 0.05

N = (1.96)2 (0.5 * 0.5) / (0.05)2

N = 3.8416 * 0.25 / 0.0025

N=384.16

Since the total number of urology nurses in the three hospitals is less than 385, a census method is used to include all of eligible nurses during the study period.

4.8. Inclusion and exclusion criteria

Inclusion Criteria:

All nurses with at least six months of work experience in the urology departments of the selected hospitals.

Nurses who give informed consent to participate.

Exclusion Criteria:

Nurses who are temporarily assigned to the department for less than six months.

4.9. Study Variables

Dependent variable:

Knowledge score (Inadequate, Average, Adequate)

Attitude score (Negative, Neutral, Positive)

Practice score (Inadequate, Average, Adequate)

Score range (1–5)

Independent variable:

Demographic features: Age, Sex

Professional characteristics: Level of education, Years of experience in urology, Formal training on disinfection practices

Work environment factors: Reported availability of PPE, Reported availability of written guidelines

4.8 Operational definition

Knowledge: The degree of factual and technical understanding demonstrated by the nurse regarding the use, risks, and protocols associated with glutaraldehyde as a HighLevel Disinfectant (HLD) in urology. A score below 60% of the maximum possible standardized score is considered inadequate, 60% to 79% is average and a score above 80% is considered adequate.

Attitude: The nurses' feelings and perceptions towards the importance of adhering to safety and disinfection protocols. It will be measured using a Likert scale. A 'Positive' attitude is (scores ranging from 3-5), 'neutral' (scores ranging from 2to 3), and 'negative' (scores ranging from 0 to 2) on the 5-point scale.

Practice: The self-reported adherence of nurses to recommended procedures for GA use. A score below 60% of the maximum possible standardized score is considered inadequate, 60% to 79% is average and a score above 80% is considered adequate.

4.9. Data collection and Data analysis

Data collected using structured, self-administered questionnaire which was developed after reviewing literatures, including existing KAP studies and safety guidelines and It has four sections:

Demographic and Professional Characteristics

Knowledge Assessment Questions

Attitude Assessment (Likert Scale)

Self-Reported Practice questions

Beforw analysis was done the data was prepared. Score of 1 given for every correct answer, while incorrect or inappropriate responses were given 0. These points were then added up to create a total score for each person. These totals were also combined to calculate an overall score across all three areas: Knowledge, Attitude, and Practice (KAP).

For the Knowledge section, which included six questions, the scores were divided into three levels based on the range of results. By dividing the range by three, a "class width" of 2 was found. This makes the scores to be grouped into three categories: 'adequate' (4–6), 'average' (2–4), and 'inadequate' (0–2).

Similar method was used to group the other sections. Practice scores were labeled as adequate (3–5), average (2–3), or inadequate (0–2). Whereas, attitudes were classified as 'positive' (3–5), 'neutral' (2–3), or 'negative' (0–2). Finally, the total combined KAP score was used to rank participants as 'adequate' (10–16), 'average' (5–10), or 'inadequate' (0–5).

Descriptive Analysis used to report simple frequencies and percentages, as well as the average (mean) scores and how much they varied (standard deviation). Independent T-Tests used to compare average scores between two specific groups and ANOVA used to compare averages across groups with more than two categories, such as different levels of education or years of experience. Pearson's Test were applied to see if there was a direct link between a nurse's knowledge, attitude, and the actual practices.

SPSS version 27 was used for analysis. p-value of less than 0.05 was used to decide if a result was statistically significant or just due to chance.

4.10. Dissemination plan

The findings of this research are to be submitted to the Department of Urology at Addis Ababa University. Additionally, the principal investigator will present it external examiners as part of the requirements for a specialty certificate in urology. Once feedback is received from the examiners, the document will be revised and prepared for submission to international journals for publication.

CHAPTER 5. RESULTS

5.1 Demographic and professional characteristics

The study included 42 participants. The majority were female (61.9%) and 57.2% the participants age ranged from 20 to 30. Nearly three-quarters (73.9%) had 1-5 years of experience in the urology department. The highest professional qualification for most nurses was a Bachelor's degree (81.0%). Importantly, 52.3% of the nurses reported having received prior formal training on disinfection practices.

Table 1 Demographic and professional characteristics of the study participants (N=42)

Variables		Frequency (n)	Percent (%)
Gender	Female	26	61.9%
	male	16	38.1%
Age	20-30	24	57.2%
	31-40	13	30.9
	>40	5	11.9%
Highest professional qualification	Diploma	2	4.8%
	Bachlors degree	34	81%
	Masters degree	6	14.2%
experience in urology(in years)	< 1 year	7	16.6%
	1-5 years	31	73.9%
	> 5 years	4	9.5%
Formal training on disinfection practices	Yes	22	52.3%

	No	20	47.7%

5.2 Analysis of knowledge score

The mean knowledge score of the study participants (Mean±SD) was 3.4±0.66. The study showed that half of the study participants (50.0%) had an average Knowledge score. While 35.7% had Inadequate knowledge, only 14.3% demonstrated adequate levels of knowledge on proper and safe GA use.

While 95.2% of the participants correctly identified the primary purpose of glutaraldehyde as HLD, Only 40.4% correctly identified all required Personal Protective Equipment (PPE) for glutaraldehyde handling.

A large proportion (28.6\%) incorrectly believed glutaraldehyde should be flushed down the drain instead of being neutralized and disposed of as biohazard waste (52.4% correct responses).

Table 2 knowledge of the study participants on glutaraldehyde use

Knowledge items	Responses	n	%
Primary purpose of glutaraldehyde	Cleaning surfaces	0	0
	HLD	40	95.2%
	Tissue preserving	2	4.8%
Minimum Recommended time of exposure for HLD	5 minutes	2	4.8%
	10minutes	5	11.9%
	20minutes	29	69.1%
	45 minutes	6	14.2%
Required PPE while handling glutaraldehude	gloves	18	42.8
	mask	2	4.8%
	Protective eye wear	4	9.6%
	Apron or lab coat	1	2.4%
	all	17	40.4%
	Skin irritation	9	21.4%

Potential health risks associated with glutaraldehyde exposure	Respiratory problems	1	2.4%
	Eye damage	2	4.8%
	Carcinogenic effect	12	28.6%
	all	18	42.8%
Method of disposal of	Flush down the drain	12	28.6%
glutaraldehyde	Neutralize and dispose as per biohazard	22	52.4%
	Open into open trash	2	4.8%
	No special method	6	14.2%
Before instruments in immersing glutaraldehyde,	lubricate with gel	2	4.8%
	Thoroughly clean and dry	28	66.7%
	c) Wipe with an alcohol swab	12	28.6%

Knowledge score (Mean±SD) 3.4±0.66; Range (1.8-4.4); Inadequate 15(35.7%), Average 21 (50.0%), Adequate 6 (14.3%);

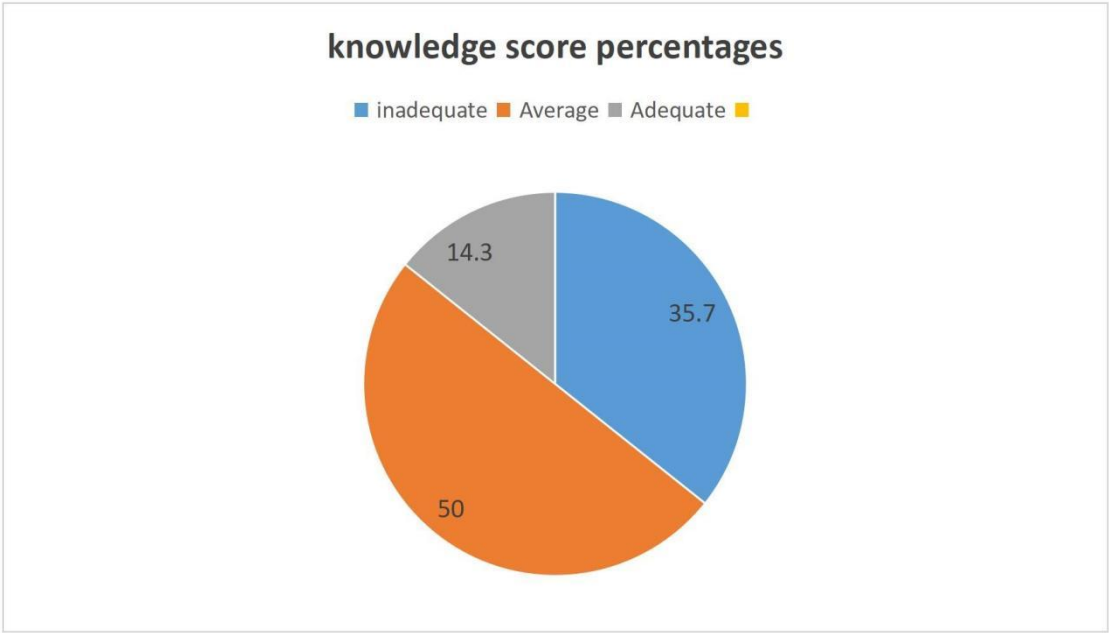

Fig.1 knowledge score percentages of study participants on glutaraldehyde use

5.3 Analysis of attitude scores

The vast majority (78.6%), had a Positive Attitude toward safety protocols with 21.4% classified as Neutral. The mean attitude score was high (392±0.46).

A crucial finding related to attitude was the participants perception of organizational support: 58.5% strongly disagreed that their workplace provides sufficient PPE and training, signaling a strong belief that institutional resources are lacking.

Table 3 Attitude of the study participants towards glutaraldehyde use

Item Description	Mean +/ SD	Strongly disagree (%)	Diagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
View of maintenance and testing of the glutaraldehyde solution as nursing duty	4.2+/-1.05	2.4	7.3	9.8	29.3	51.2
Workplace provision of sufficient PPE and training	2.61+/-1.00	58.5	17.1	24.4	0.0	0.0
following strict safety protocols for reducing long-term health risks	4.37+/-0.95	0.0	0.0	9.8	53.7	46.3
strict adherence to disinfection guidelines and Patient Safety	4.93+/-0.26	0.0	0.0	0.0	7.3	92.7

Attitude score (Mean±SD) 3.99±0.46; Negative 0 (0%), Neutral 9 (21.4%), Positive 33(78.6%)

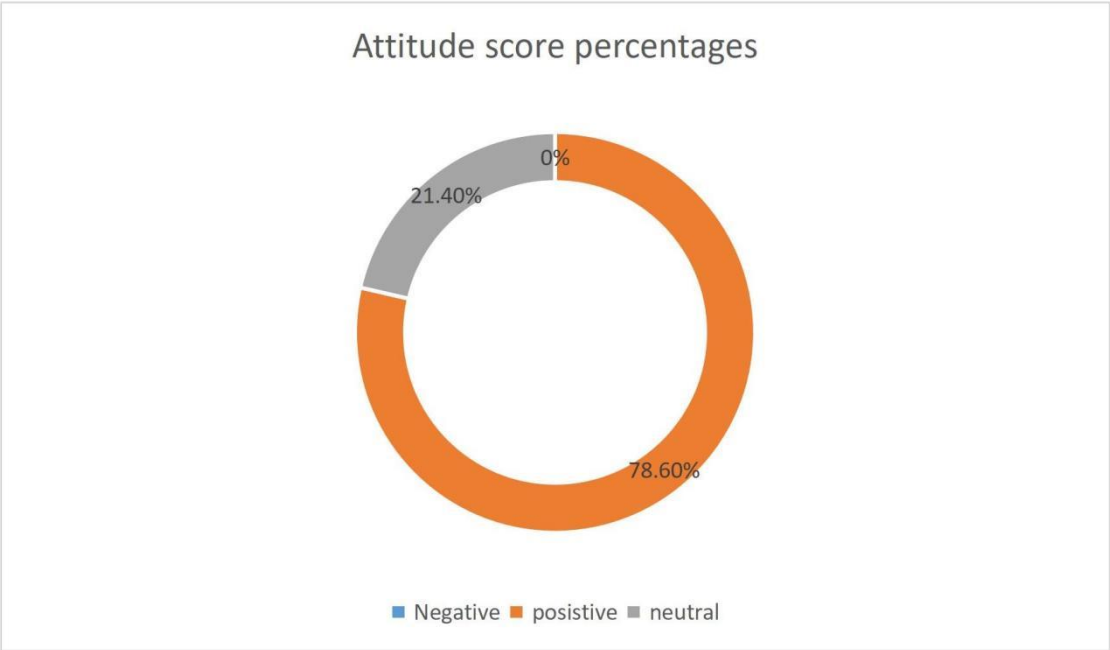

Fig.2 Attitude score percentages of study participants on glutaraldehyde use

5.4 Analysis of practice scores

Actual adherence to safe practices was significantly poor, failing to align with the positive attitudes observed. The mean practice score was low which is 2.60 ±0.51 (on a standardized scale, range 1.0 - 5.0). 46.3% of the participants exhibited Inadequate Practice, 51.2% were Average, and only 2.4% demonstrated Adequate Practice. Nearly half of the participants (47.7%) reported using required PPE inconsistently. Moreover, 66.7% of the participants reported Never attending refresher disinfection training.

Table 4 glutaraldehyde use practices among the study participants

Practice items		n	%
Use of Personal Protective Equipment (PPE)	Always	22	52.3%
	Sometimes	10	23.8%
	Rarely	8	19.1%
	Never	2	4.8%
Storage Method of Glutaraldehyde	tightly sealed container in a ventilated area	28	66.7%
	in an open container	12	28.5

	alongside patient care supplies	2	4.8%
MEC test strip to check the solution before every disinfection cycle	Yes	0	0
	No	42	100%
Availability and use of written, facilityspecific standard operating procedures (SOPs) for glutaraldehyde use	yes	0	0
	No	42	100%
Precautions during Glutaraldehyde Handling	Fume hoods	0	0%
	Limit exposure time	4	9.6%
	Ensure adequate ventilation	4	9.6%
	Avoiding splashing	2	4.8%
	All except fume hood	22	52.3%
Attending Refresher Disinfection Training	Anually	0	0%
	Biannually	0	0%
	Rarely	14	33.3%
	Never	28	66.7%

Practice score (Mean±SD) 2.60 +-0.51; Inadequate 19(46.3%), Average 21(51.2%), Adequate 1(2.4%) , Score range (1–5)

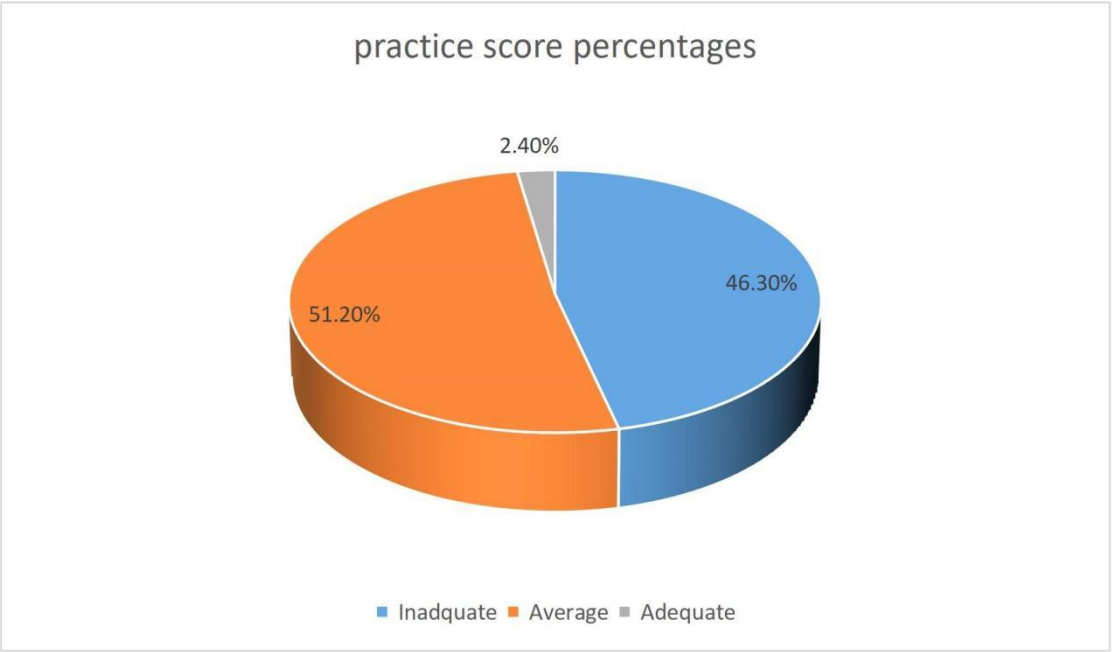

Fig. 3 Practice score percentages among study participants

5.5 Comparison of KAP Scores Across Groups

There was statistically significant difference in the Overall KAP scores based on the status of formal training on disinfection practices (P = 0.007). participants who reported receiving Formal Training scored substantially higher on the Overall KAP mean (3.99± 0.32) compared to those who did not (3.15±0.22). The other statistically significant difference in the Overall KAP scores was observed across professional qualification groups (P = 0.036). participants with a Master's degree had the highest Mean Overall KAP score (3.97±0.33). However, variables like Gender (P=0.961) and Experience in Urology (P=0.945) showed no statistically significant difference in their impact on the Overall KAP score.

Table 5 Comparison of knowledge, attitude, and practice scores on glutaraldehyde use in different groups

Variable	Category	N	%	Knowledge (Mean +\SD)	Attitude (Mean +\- SD)	Practice (Mean +\- SD)	Overall KAP (Mean +\SD)	P-value (KAP Overall)
Gender	Female	26	61.9	3.38 .76	+/-03.88 +\- 0.44	2.67 +\0.45	3.61 +\0.28	0.961

	Male	16	38.1	3.40 0.81	+\-4.16 +\- 0.46	2.46 +\0.60	3.41 +\0.28	0.961
Highest professional qualification	Diploma	2	4.8 %	3.10 0.63	+\- 3.69 +\- 0.37	2.80 \0.56	3.20 +/0.29	0.783
	Bachlors degree	34	81%	3.45 0.61	+\- 4.12 +\- 0.49	2.52 +\0.33	3.47 +\0.20	0.687
	Masters degree	6	14.2 %	3.80+ 0.75	\- 3.75 +\- 0.35	2.66 +\0.72	3.97 +\0.33	0.036
	< 1 year	7	16.6 %	3.20 0.00	+\-4.00 +\0.00	2.80 +\0.00	3.33 +\0.00	0.945
	1-5 years	31	73.9 %	3.47 1.15	+\- 4.00 +\0.87	2.80 +\0.69	3.42 +\0.33	0.875
experience in urology(in years)	> 5 years	4	9.5 %	3.44 0.65	3.93 +\-+\- 0.43	2.54 +\0.52	3.47 +\0.27	0.069
	Yes	20	48.8	3.88+ 0.60	\- 4.05 +\0.46	2.47 +- 0.47	3.99+ \- 0.32	0.007
Formal Training on glutaraldehyde use	No	21	51.2	2.83+ 0.73	3.90 \-+\- 0.46	2.71 +/0.53	3.15 +\0.22	0.342

Overall KAP: Inadequate 2(4.8%), Average 22 (52.3%), Adequate 18 (42.8%)

5.6 Correlation Analysis of KAP Domains

Pearson's correlation was calculated to check what the linear relationships between the three domains of Knowledge, Attitude, and Practice regarding glutaraldehyde use looks like. The analysis showed a significant positive linear correlation between knowledge and attitude ($r=0.238$, $p<0.05$). This implies that as participant's knowledge scores increased, they were statistically more likely to show a positive attitude toward safety protocols. However, the analysis also did not reveal significant correlation between knowledge and practice ($r=0.03$ $p>0.05$), and between attitude and practice ($r=0.0$, $p>0.05$).

CHAPTER 6. DISCUSSION

6.1. overview

This study undertook a comprehensive assessment of the knowledge, attitude, and practice of nurses regarding the safe and effective use of glutaraldehyde in the urology departments of three major tertiary hospitals in Addis Ababa: Tikur Anbessa Specialized Hospital, Yekatit 12 Hospital Medical College, and Minilik II Comprehensive Specialized Hospital. Since glutaraldehyde plays such a big role as a high-level disinfectant for heat-sensitive urology tools, it is understood that the proper knowledge and consistent use of cleaning protocols are essential. These steps are seen as the primary way to prevent hospital-acquired infections and to keep staff safe from chemical risks.

However, a significant disconnect between the knowledge, beliefs, and actual clinical practices of nurses was revealed by the findings of this research. While positive attitudes toward safety and infection prevention were demonstrated by many participants, their actual practices were found to be inadequate.

6.2. Assessment of Knowledge and Attitude

While most participants (95.2%) recognized glutaraldehyde as a high-level disinfectant, only 14.3% showed a full understanding of its use, and 35.7% were found to have inadequate knowledge. It was noted that only 40.4% could identify all the PPE required for safe handling, and 28.6% wrongly believed that the chemical could be poured down the drain. These results suggest that the participants' factual understanding of the protocols is not yet where it needs to be.

These findings are consistent with research from other resource limited regions. For instance, in a Brazilian study by Barbosa et al. (2010), it was documented that a poor understanding of protocols led to mistakes in every step: only 40% of instruments were pre-washed, 55% of internal channels were not filled, and only 20% met the required soaking time. These gaps are very similar to what was seen in this study, where only 69.1% of participants knew the disinfectant needs at least 20 minutes to work. The dangers of these knowledge gaps were also highlighted in an Indian study by Bawana et al., where contaminated instruments led to infections in 3.1% of surgeries. In contrast, staff in more structured systems tend to show much higher knowledge levels; in a German study by Martiny et al., nearly 100% of staff recognized cleaning as the most important step.

Attitudes toward safety were found to be very high, with 78.6% of participants showing a positive outlook and none showing a negative one. Most strongly agreed that following guidelines is essential for patient safety (92.7%) and that testing the strength of the solution is critical (51.2%). This resembles a survey from the UK where nurses expressed strong support for safety measures like ventilation and PPE, even when they couldn't always follow them in practice.

A key finding in this study is that 58.5% of nurses strongly feel that their hospitals do not provide enough training or PPE despite their stromg positive attitude. This same pattern has been reported in Brazil and India. Even in high-income settings like the UK, nurses have been found to suffer from eye and lung irritation because ventilation systems were insufficient, despite the nurses themselves being well aware of the risks.

Finally, a clear link was found between knowledge and attitude; the more a nurse knows, the more likely they are to support and follow safety measures.

6.3. Assessment of Practice on Glutaraldehyde Use

Despite high levels of positive attitudes, actual practice was found to be poor. Inadequate practice was demonstrated by 46.3% of the participants, while only achieved an adequate level. This major gap between what nurses believe and what they actually do highlights systemic failures that make safe reprocessing very difficult.

Several findings are particularly concerning: PPE was used inconsistently by 47.7% of the staff, and 100% reported that they did not use the required test strips to check the strength of the chemical. Furthermore, a total lack of written, facility-specific standard operating procedures was reported by all participants. Training was also a major issue, as 66.7% had never attended a refresher course. Additionally, 28.5% of the glutaraldehyde was stored in open containers, and despite its importance for controlling dangerous vapors, no facility was found to have a fume hood.

These challenges have been documented in other regions as well. For example, a national survey in Italy by Lazzari et al. (2022) reported significant deficiencies in how staff were prepared for endoscope reprocessing. It was found that only 10% of centers provided formal theoretical training before staff started the job, and 9% of facilities had no supervision at all during the process. Moreover, regular refresher training was implemented in only 38% of the centers evaluated.

6.4. The Inadequate Practice and the Knowledge-Attitude-Practice Gap

The weak and statistically non-significant correlations found in this study between practice and knowledge ($r = 0.03$) and between practice and attitude ($r = 0.02$) strongly indicate that unsafe glutaraldehyde use is not the result of poor motivation or limited understanding among nurses. Rathe, systemic barriers such as inadequate infrastructure, absence of written protocols, insufficient training, and lack of routine supervision. Similar condition have been documented in several other studies. For example, Barbosa et al. (2010) in Brazil reported that endoscope reprocessing failures persisted even among staff who demonstrated good theoretical understanding of disinfection procedures. The authors attributed failures in the reprocessing steps mainly to institutional shortcomings rather than individual attitudes or knowledge (16). Likewise, Chiu et al. (2012) examined endoscope reprocessing in hospitals in Hong Kong and similarly reported that high staff awareness did not change into correct practice. Their study demonstrated that compliance improved only when hospitals introduced formal auditing systems and standardized checklists which highlights the importance of structural support rather than individual level factors (15). In Germany, inspections of urology clinics in Frankfurt conducted by Schwarz et al. (2008) revealed that only 2 of 8private practices fully

complied with the Robert Koch Institute (RKI) guidelines at first. However, after the introduction of structured feedback, routine oversight, and mandatory documentation, compliance increased across the remaining centers
(17). This notable improvement following external regulatory intervention underscores the essential role of systematic supervision, an element that was completely absent in the Ethiopian hospitals included in the present study. Similarly, a survey of reprocessing facilities in Italy by Lazzari et al. (2022) found that
compliance with disinfection standards was significantly higher in institutions with formal monitoring and regular refresher training. Facilities lacking such systems exhibited widespread problems in drying, storage, and disinfectant monitoring procedures regardless of staff attitude or years of experience (13).

6.5. Occupational Health Implications

Glutaraldehyde is a well-documented respiratory and dermatologic sensitizer, and repeated exposure can lead to cumulative health effects. The fact that 47.7% of this study participants used PPE inconsistently and 0% reported access to a fume hood which shows important vulnerability in the working environment. Takigawa and Endo (2006) demostrated occupational exposure can cause different symptoms including occupational asthma, chronic bronchitis, dermatitis, skin sensitization, and eye irritation (19). González et al. (2013) in Spain found that nurses exposed to GA without proper protective measures had significantly higher rates of skin problems and eye irritation. moreover, the study showed that symptoms decreased significantly after the introduction of ventilation controls highlighting the effectiveness of structural interventions (12). A study by Chongtham et al. (2015) in India reported that endoscopy nurses commonly experienced headaches, throat irritation, and shortness of breath due to the combination of poor ventilation, lack of PPE, and prolonged exposure times (14). similarly , Ahn et al. (2010) in South Korea found that healthcare workers exposed to GA without adequate ventilation had elevated levels of airway inflammation markers, even when PPE use was reported as “regular but incomplete”(11). Countries with strong regulatory frameworks on the other hand show markedly lowered occupational symptoms. A follow-up study in Frankfurt by Schwarz et al. (2008) found that symptoms like chronic cough and eye irritation decreased in facilities that installed proper ventilation and moved from manual cleaning to automated disinfection (17).

Ultimately, the situation in Ethiopia appears to be similar to the high-risk environments described in other low- and middle-income countries which expose nurses to avoidable chemical hazards showing an urgent need for intervention.

6.6. Factors Associated with KAP Scores

This study found that formal training ($p = 0.007$) and education level ($p = 0.036$) were important predictors of a nurse’s overall knowledge, attitude, and practice. The results from this study have similarity to the research from Ramos et al. (2018) in Brazil, which showed that nurses with formal training were 2.5 times more likely to follow disinfection protocols correctly. It was also shown that higher education levels generally lead to a better understanding of guidelines (10).

Similarly, studies from India and South Africa have shown that nurses who receive specific infection control training are more consistent in how they handle chemicals, use PPE, and maintain documentation (14,9). This matches the findings of the current study, where formal training was associated to higher overall scores.

Interestingly, neither years of experience nor gender were found to be significantly associated to the nurses handling of glutaraldehyde. This is consistent with other research, such as a study in Saudi Arabia by Al-Abdely et al. (2016), which found that experience alone does not guarantee that protocols will be followed unless it is supported with structured training and supervision (21). The study also reported no differences between genders, emphasizing that professional performance is affected more by institutional support and education than by personal background.

CHAPTER 7. STRENGTHES AND LIMITATIONS

This study is the first in Ethiopia which address the Knowledge,
Attitude, and Practice (KAP) of nurses regarding glutaraldehyde specifically for reprocessing of urology instruments.Therefore, the findings provide the foundational data. Additionally, By utilizing a census and including all eligible nurses who are involved in GA use for instrument reprocessing, the finding from this research represents the practice the institutions where the study took place. Some of the findings from this study such as the 100% reported lack of written Standard Operating Procedures and Minimum Effective Concentration test strips gives important information for hospital administrators. However, the research has its own limitations limitations which needs to be considered. Being a cross-sectional study which limits its ability give causal relationship. Fore example, while the data shows a strong association between the lack of Standard Operating Procedures and poor practice, the study cannot definitively prove that the absence of Standard Operating Procedures causes the poor practice; it can only demonstrate that they coexist. The study did not include direct observational audits of the instrument reprocessing process or environmental monitoring of glutaraldehyde vapor concentrations. Direct observation would have provided objective, non-self-reported data on procedural compliance, while environmental monitoring would have provided objective evidence of staff exposure risk. The reliance solely on self-reported data is a constraint.

CHAPTER 8. CONCLUSION AND RECOMMENDATIONS

8.1. Conclusion

The study participants in this study expressed low knowledge and Practice score despite a highly positive Attitude. The understanding of the proper use and safety employed in urological instrument re processing using GA is inadequate among the nurses in addition to the reported deficiency of necessary resources. This underscores the need for Resource Provision and undertaking regular educational programs on proper and safe use of GA.

8.2. Recommendations

Ensure a consistent supply of appropriate PPE, MEC test strips, proper local exhaust ventilation

Implement written Standard Operating Procedures and regular monitoring

Implement Safe Disposal Protocol

Ensure that the staffs get periodic training

Future studies should incorporate direct observational audits to provide objective data on practice compliance, which is necessary to eliminate the possibility of selfreporting bias.

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Annexes

KAP assessment questionnaire on the use of glutaraldehyde for disinfecting endoscopic instruments Section 1: Demographic Information

Age: _____

Gender: _____

Years of experience in urology: _____

Highest professional qualification:

a) Diploma

b) Bachelor's degree

c) Master's degree

d) Other (specify)

Have you received formal training on disinfection practices?

a) Yes

b) No

Section 2: Knowledge

1. What is the primary purpose of glutaraldehyde in medical practice?

a) Cleaning surfaces

b) High-level disinfection of instruments

c) Preserving tissues

d) None of the above

2. What is the minimum recommended exposure time for glutaraldehyde to achieve effective disinfection?

a) 5 minutes

b) 10 minutes

c) 20 minutes

d) 45 minutes

3.Which PPE is mandatory when handling glutaraldehyde? (Select all that apply)

a) Gloves

b) Mask or respirator

c) Protective eyewear

d) Apron or lab coat

4. What are the potential health risks associated with prolonged exposure to glutaraldehyde? (Select all that apply)

a) Skin irritation

b) Respiratory problems

c) Eye damage

d) Carcinogenic effects

5. How should used glutaraldehyde be disposed of?

a) Flush down the drain

b) Neutralize and dispose as per biohazard waste protocols

c) Pour into open trash

d) No special method

6. Before immersing instruments in glutaraldehyde, they must be

a) lubricated with gel

b) Thoroughly cleaned and dried

c) Wiped with an alcohol swab

Section 3: Attitude

1. Do you believe strict adherence to disinfection guidelines prevents patient cross-contamination.? a) Strongly agree

b) Agree

c) Neutral

d) Disagree

e) Strongly disagree

2. I believe that following strict safety protocols reduces my long-term health risks effectively? a) Strongly agree

b) Agree

c) Neutral

d) Disagree

e) Strongly disagree

3. do you believe your employer provides sufficient training and resources for the safe use of glutaraldehyde?

a) Strongly agree

b) Agree

c) Neutral

d) Disagree

e) Strongly disagree

4. I view the maintenance and testing of the glutaraldehyde solution as a critical nursing duty? a) Strongly agree

b) Agree

c) Neutral

d) Disagree

e) Strongly disagree

Section 4: Practice

1. How often do you use PPE while handling glutaraldehyde?

a) Always

b) Sometimes

c) Rarely

d) Never

2. How is glutaraldehyde stored in your facility?

a) In a tightly sealed container in a ventilated area

b) In an open container

c) Alongside patient care supplies

d) Other (specify)

3. I use the minimum effective concentration (MEC) test strip to check the solution before every disinfection cycle.

a) yes

b) no

4. written, facility-specific standard operating procedures (SOPs) for glutaraldehyde use is available and I follow it .

a) yes

b) no

5. When handling glutaraldehyde, what additional precautions do you take? (Select all that apply)

a) Use a fume hood

b) Limit exposure time

c) Ensure adequate ventilation

d) Avoid splashing

6. How often do you attend refresher training on infection control and disinfection?

a) Annually

b) Biannually

c) Rarely

d) Never