Risk Management and Healthcare Policy

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ORIGINAL RESEARCH

Adherence to Standard Precautions and Associated Factors Among Healthcare Workers at Public and Private Hospitals in Northeast Ethiopia

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Introduction: Standard precautions are crucial for infection control in healthcare. Studies show public hospitals' adherence, but data on private hospitals are scarce. Understanding this disparity is vital for safety, policy, and better patient outcomes. Hence, this study aimed to assess precautions and associated factors among healthcare workers at public and private hospitals in Northeast Ethiopia.

Methods: A comparative cross-sectional study compared healthcare institutions. A total of 470 workers participated via stratified random sampling. Data collection used a pre-tested questionnaire and observation checklist. Epi data managed entry, while STATA analyzed. Binary logistic regression determined significance ($P<0.05$) for variables.

Results: The overall adherence to standard precautions was 51.6% (95% confidence interval (CI): 46.9–56.2). At public and private hospitals, it was 52.2% (95% CI: 45.6–58.6) and 60.4% (95% CI: 53.9–66.9), respectively. In public hospitals adherence was affected by female sex [adjusted odds ratio (AOR): 2.58; 95% CI: 1.32–5.02], availability of written guidelines [AOR: 3.10; 95% CI: 1.62–5.94], having good knowledge [AOR: 2.05; 95% CI: 1.03–4.11] and favorable attitude towards standard precautions [AOR: 2.21; 95% CI: 1.14–4.27]. In private hospitals, it was affected by the availability of running tape water [AOR: 2.36; 95% CI: 1.10–5.04], personal protective equipment (AOR: 2.22; 95% CI; 1.01–4.93), color-coded dust bins [AOR: 2.33; 95% CI: 1.04–5.21], having good knowledge [AOR: 2.10; 95% CI: 1.07–4.13] and favorable attitude [AOR: 2.63; 95% CI: 1.39–4.97].

Conclusion: The adherence to standard precautions was higher among private than public hospital healthcare workers in Dessie City, Ethiopia. Thus, ensuring adequate availability of personal protective equipment, safety materials, and running tap water in working rooms, particularly in public hospitals is highly recommended. The initiatives aimed at promoting adherence to standard precautions should be designed and put into action for public hospitals.

Keywords: adherence, precautions, personnel, health, facility

Introduction

Standard precaution is the basic minimum standard of hygiene in a healthcare facility to be applied throughout all contact with blood or body fluids from any patient or source regardless of diagnosis or infection status.[1,2] Standard precautions are designed to prevent healthcare workers from being exposed to potentially infected blood and body fluids by applying the fundamental principles of infection control through hand washing and the utilization of appropriate protective barriers such as gloves, masks, gowns, and eyewear.[3] In addition, the standard precautions stipulate that healthcare workers (HCWs) take precautions to prevent injuries caused by needles, scalpels, and other sharp instruments or devices during procedures and disposals.[3,4]

The World Health Organization (WHO) estimates that about 3 million HCWs face occupational exposure to blood-borne viruses each year worldwide (2 million to HBV, 900,000 to HCV, and 300,000 to HIV), and 90% of the infections

Received: 10 February 2024
Accepted: 13 May 2024
Published: 13 June 2024

that result from these exposures are in low-income countries.[1] European Center for Disease Prevention and Control (CDC) reports showed that the prevalence of Hospital-acquired infections (HAIs) ranges between 4.6% and 9.3% in European countries and also the center reported that five million patients develop infections as a result of health care in Europe, contributing for 135,000 deaths per year.[5]

Unless appropriate standard precautions are in place, healthcare facilities can be the source of infection and epidemic disease for the community at large. In the United States of America, hospital-acquired infections affect nearly 2 million hospitalized patients annually and are both costly and potentially life-threatening.[6] Developing countries have about 20 times the risk of contracting a nosocomial infection compared with developed countries.[7] A systematic review done in the African region revealed that nosocomial infection magnitude would be much higher in developing than in developed nations.[8] It is estimated that up to 70% of some types of hospital-acquired infections are preventable through improved infection control practices among healthcare workers.[9]

Healthcare workers are exposed to blood and other body fluids in the course of their work. According to a few studies conducted among healthcare workers, there was poor adherence to standard precautions as recommended by national guidelines. Among these, a study conducted in Nigeria found that only 52.1% of healthcare workers "always" adhered to preventive safety.[10] Similarly, in Ethiopia adherence to standard precautions among healthcare workers was reported to be inadequate regarding eye protection, avoidance of needle recapping, glove use when required, washing hands before and after patient contact, use of face masks, and implementation of precautions for all patients.[11–13] Ethiopia has a dual health system such as the public sector, which comprises government health organizations that serve primarily the indigent population, and the private sector, which comprises for-profit and "not-for-profit" organizations, that serve the population that can afford care on an out-of-pocket basis.[14] In Ethiopia, where healthcare services are largely covered by mid-level healthcare workers, assessing the necessary practices on standard precaution and associated factors in hospitals as early as possible can give ways to manage the limited resources available in the facilities.[11]

Major reported factors that affect adherence to standard precautions include but are not limited to lack of knowledge and negative attitude among healthcare workers on standard precautions,[15–17] lack of resources, lack of training, absence of monitoring and evaluation, forgetfulness, negligence, low-risk perception, and insufficient support from management in creating conducive work environment.[13,16] Furthermore, socio-demographic variables such as age, sex, job category, marital status, educational status, and work experience were found to be associated with adherence to standard precautions.[18–21]

Essential measures known as standard precautions are imperative for achieving the highest level of infection control within healthcare facilities. While some studies have investigated healthcare workers' adherence to standard precautions in public hospitals, there is a notable lack of information to draw comparisons with adherence in private hospitals, it elucidates crucial insights for enhancing healthcare safety, informing policy, and ultimately improving patient outcomes. Hence, this study aimed to assess precautions and associated factors among healthcare workers at public and private hospitals in Northeast Ethiopia.

Methods

Study Design, Period, and Setting

An institution-based comparative cross-sectional study was conducted in Dessie City from April 1 to 30, 2021. The study was conducted at public and private hospitals in Dessie city. Dessie city is one of the metropolitan cities in Amhara National Regional State, which lies at an altitude of 2470 meters above sea level. It is surrounded by the imposing Tossa mountain that overlooks the city in the west. According to the CSA population projection for 2021, a total of 610,431 people live in 5 sub-cities in addition to 26 kebeles (the lowest administrative level in Ethiopia), of which 18 are urban. Dessie City is located 401 kilometers from Addis Ababa, the capital city of Ethiopia, and 488 kilometers from Bahir Dar, the capital city of the Amhara National Administrative Regional State. It has two governmental hospitals, eight public health centers, and five general private hospitals serving Dessie City and the surrounding more than 8 million people of the catchment area (East Amhara, part of Tigray, and Afar region). The public hospitals are Dessie Referral Hospital and Boru Hospital. The total number of beds is 240 in Dessie Referral Hospital (55% bed occupancy) and 120 in Boru

Hospital (45% bed occupancy). The number of beds (bed occupancy) for the five private hospitals is as follows: Selam general hospital has 90 beds (75% occupancy), Ethio general hospital has 75 beds (80% occupancy), Bati general hospital has 60 beds (80% occupancy), Tossa general hospital has 50 beds (70% occupancy), and Meseret general hospital has 35 beds (90% occupancy). There are 543 and 264 healthcare workers in public and private hospitals in Dessie city, respectively.[22] Our study subjects included specialists of all types, general practitioners, nurses of all types, midwives of all types, laboratory technicians of all types, health officers, and anesthesiologists of all types. According to the information obtained from the city administrative office, they provide different services in the outpatient department, inpatient department, and operation room theatre department.[22]

Patient Involvement

It was not appropriate or possible to involve patients in the design, conduct, reporting, or dissemination plans of our research since the study was done on healthcare workers.

Population

All healthcare workers who were working at public and private hospitals in Dessie City were the source Population and all fully employed healthcare workers who were working at public and private hospitals in Dessie City were the study population.

Eligibility Criteria

The study included all fully employed healthcare workers, who were working at public and private hospitals in Dessie city. Healthcare workers, who were on annual and other kinds of leave during the data collection period, were excluded from the study.

Sample Size Determination and Sampling Procedure

The sample size was calculated for all objectives. Objective one and two it was calculated with double population proportion formula by taking a proportion of standard precaution adherence from a similar study done in Dessie referral hospital[23] at public hospitals (P1=0.23) and private hospitals (P2=0.38), at 95% confidence level =1.96 and power (80%) =0.842 and considering 10% non-response rate. For P2, a 15% difference is assumed between public and private hospitals, because there was no previous study on private hospitals.[24]

$$\text{Sample size in each group(n1)} = \frac{[(P1(1-P1)+(P2(1-P2))]\left(Z\frac{\alpha}{2}+Z\beta\right)^2}{(P1-P2)^2}$$

$$= \frac{[(0.23(1-0.23)+(0.38(1-0.38))](1.96+0.842)^2}{(0.23-0.38)^2}$$

$$= \frac{(0.1771+(0.2356)(2.802)^2}{(0.15)^2} = 144$$

Sample size in each group(n1): Where: n_1= is the initial sample size, P_1= is the proportion of adherence to SP practice among healthcare workers working at public hospitals, P_2 = is the proportion of adherence to SP practice among healthcare workers working at private hospitals, Z_β = power (by taking 80%)=0.842, n_1: n_2= ratio of public to private hospital workers 1:1 and $Z_{\alpha/2}$= standard normal variation value at a confidence interval of 95% (1.96). This shows the final sample size was 158 for public hospitals and 158 for private hospitals, a total of 316 participants after adding a 10% non-response rate.

The sample size for the third and fourth objectives was determined by calculating factors using Epi info version 7.2.1 for different variables, the sample size was calculated and described in (Table 1). Assuming cross-sectional; unexposed:

Table 1 Sample Size Determination for Adherence to Standard Precaution Practice and Associated Factors Among Healthcare Workers at Public and Private Hospitals in Dessie City, Northeast, Ethiopia, 2021

No	Factors		Assumptions	Proportions	Initial Sample Size	COR	Final Sample Size with a 10% Non-Respondent Rate	Reference
1	Training on IP	Yes	95% CI Power=80% Ratio=1:1	P1=0.302 P2=0.135	214	2.77 (1.68,4.50)	214+21=(235 for public, 235 for private) =470	[24]
		No						
2	Sex	Female		P1=0.377 P2=0.111	94	4.85 (2.34,6.40)	94+9=(103 for public, 103 for private) =206	[24]
		Male						

Abbreviation: IP, infection prevention.

exposed (1:1) using power approach, from a similar study done in Hawassa University comprehensive specialized hospital.[24]

Therefore, by taking the largest sample size from all, the final sample size (n) was 470 participants, 235 for public hospitals (n_1), and 235 for private hospitals (n_2).

The study employed a stratified random sampling technique to ensure representation across hospital types. Hospitals were stratified into five private and two public categories, with all city hospitals included. Participants were then randomly sampled, considering professional category and proportional allocation. Sampling frames were obtained from hospital human resource departments. Sample sizes were determined using a proportional allocation formula, ensuring representation from each professional stratum based on the total healthcare workers in each hospital. This method yielded a total sample size of 470, with 235 participants selected from both the public and private sectors(Figure 1).

Study Variables

Adherence to standard precautions was the outcome variable of the study. Explanatory variables of the study were socio-demographic factors (age, sex, marital status, service year, monthly income, risk allowance, educational status, professional category, working department and working hours), health institution-related factors/issues (availability of running water and soap, personal protective equipment, antiseptics, safety box, infection prevention guidelines, training on standard precautions, regular supportive supervision and encouragement by facility management), and monitoring and evaluation, and individual factors (knowledge and attitude of health care workers towards standard precautions).

Operational Definitions

Adherence to Standard Precaution

Complete follow-up and practice of prescribed Infection Prevention Practices and Control (IPPC) in the workplace all the time and for all patients, such as hand hygiene adherence, utilization of PPEs whenever necessary according to standard, sharp materials safety practices, sterilization and disinfection of instruments, health care waste management, availing policies and guidelines in working classes and providing training for HCWs.

Adherence to standard precautions was measured using 26 items on a five-point Likert scale (1=never, 2=seldom, 3=sometimes, 4=often, 5=always). Healthcare workers scoring greater than and equal to the median score were considered as having good adherence with standard precautions and scores less than the median score were considered as poor adherence.[25,26]

Knowledge

Knowledge refers to having an adequate understanding of concepts, contents, and activities of standard precaution among health care workers.

Knowledge about standard precautions was measured using the cumulative score of 8 items each with two possible responses [1 “yes”, 0 “no”]. Participants who scored greater than and equal to the mean value for the cumulative score of

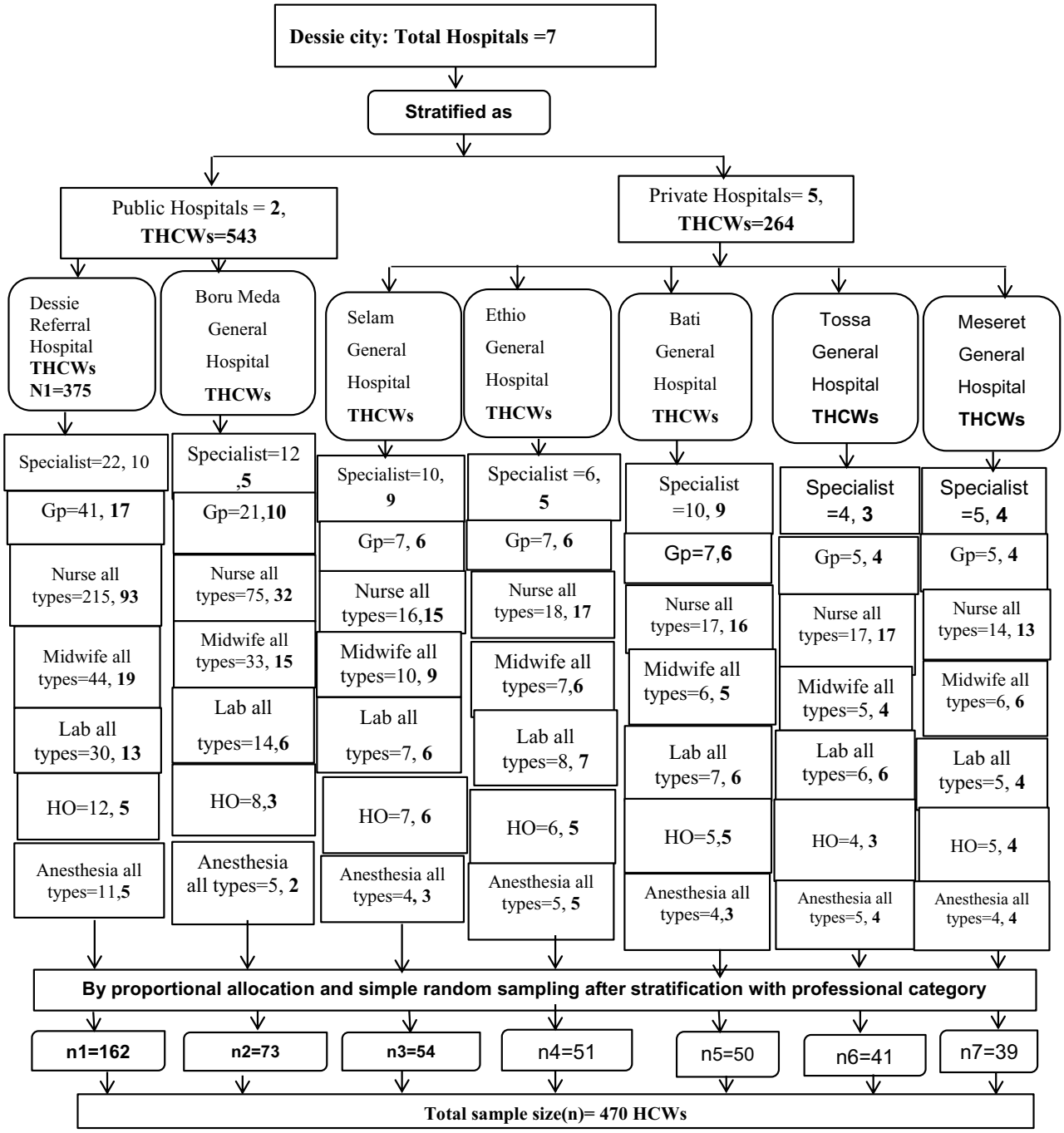

Figure 1 Sampling procedures among health care workers at public and private hospitals in Dessie city, Northeast Ethiopia: 2021.

knowledge questions were labeled as "good knowledge" and those who scored less than the mean value as "poor knowledge".[12,27,28]

Attitude

Attitude is a belief and intention to follow the principles of standard precaution by health care workers. Ten items were used on the Likert scale using a degree of agreement response: strongly disagree, disagree, neutral, agree, and strongly agree to measure the attitude. Then, all individual responses were computed to obtain the total score and calculated for

medians. Then, responses greater than and equal to the median value were considered as favorable attitude, while responses less than the median value were considered as unfavorable attitude.

Data Collection Instruments and Procedures

Data were collected using a structured pre-tested self-administered questionnaire. Four trained B.Sc. nurses and two senior public health officers were recruited for data collection and supervision, respectively. The questionnaire was adapted from different literature and Ethiopian infection prevention and control (IPC) guidelines.[5,11–13,15,24]

The questionnaire underwent a rigorous translation process from English to Amharic and back, ensuring consistency. Comprising socio-demographic, knowledge, attitude, hospital-related, and adherence sections, it exhibited strong reliability with coefficients of 0.772, 0.783, and 0.694 for knowledge, attitude, and adherence, respectively, and 0.810 overall. Before distribution, the principal investigator and a data collector conducted observations using a checklist to maintain data integrity. They assessed standard precautions across various hospital units, aligning with previous studies and literature for checklist preparation, ensuring comprehensive coverage of hand hygiene, PPE availability, instrument processing, waste segregation, and disposal. This meticulous approach safeguards the reliability and validity of the study's findings, promoting accurate assessments of healthcare workers' adherence to standard precautions and facilitating informed interventions to enhance healthcare safety.[12,29]

Data Quality Assurance and Management

Cronbach's alpha reliability test ensured the tool's reliability for each component. A pretest involving 5% of the sample was conducted at Kombolcha General Hospital, similar to study settings. Following pretesting, questionnaires were refined for clarity. Facilitators and supervisors received comprehensive training on study objectives, confidentiality, questionnaire administration, and fieldwork. Daily supervision by supervisors and principal investigators ensured data integrity. Completed questionnaires underwent immediate checks for completeness, clarity, and accuracy post-data collection.

Data Processing and Analysis

Data were meticulously checked for completeness and consistency, then compiled, coded, and entered into Epi-data version 3.1. Errors were rectified by revising the original data using code numbers assigned to questionnaires. Each questionnaire's soft copy was cross-checked with its hard copy for consistency before cleaning to address missing values, outliers, and inconsistencies. Cleaning involved frequency checks for missing values and descending/ascending order checks for outliers. The cleaned data were exported to STATA version 14.1 for analysis. Descriptive statistics were summarized using frequencies and cross-tabulations, with tables and figures utilized for data presentation, logistic regression was employed for both bivariate and multivariable analysis, utilizing Enter Methods to assess the relationship between independent and dependent variables. Variables with p-values <0.2 in bivariate analysis were considered for multivariable regression. Significance was determined at $p<0.05$ in multivariable analysis. Observation data determined proportions. Model adequacy was assessed using the Hosmer and Lemeshow goodness-of-fit test. Multicollinearity was evaluated using the variance inflation factor (VIF) diagnostic test among independently associated variables.

Results

Socio-Demographic Characteristics of the Respondents

A total of 450 participants completed the study with a response rate of 95.7%. Of these, 230 with a response rate of 97.9% were from the public, and 220 with a response rate of 93.6% were from private hospitals. The median age of the study participants was 29 (Inter quartile Range (IQR): 27–34) years for public and 30 (IQR: 28–34) years for private hospitals. The highest number of the study participants 118 (51.3%) in public hospitals were under the age category of 20 to 29 years, whereas the highest number of study participants 109 (49.5%) in private hospitals were under the age category between 30 and 39 years. More than half (51.3%) of the participants in public hospitals were males; however, more than half (53.2%) of the participants in private hospitals were females (Table 2).

Table 2 Socio-Demographic Characteristics of the Respondents at Public and Private Hospitals, Dessie City, Ethiopia, April 2021 (n=450)

Characteristics	Public Hospitals (n=230) No (%)	Private Hospitals (n=220) No (%)	Total (n=450) No (%)
Place work of respondents			
CS Hospital	160 (69.6)	0	160 (35.6)
General Hospital	70 (30.4)	220 (100.0)	290 (64.4)
Sex			
Male	118 (51.3)	103 (46.8)	221 (49.1)
Female	112 (48.7)	117 (53.2)	229 (50.9)
Age in years			
20–29	118 (51.3)	100 (45.5)	218 (48.4)
30–39	95 (41.3)	109 (49.5)	204 (45.4)
≥40	17 (7.4)	11 (5.0)	28 (6.2)
Marital status			
Married	124 (53.9)	129 (58.6)	253 (56.2)
Single	69 (30.0)	75 (34.1)	144 (32.0)
Separated	16 (7.0)	6 (2.7)	22 (4.9)
Divorced	12 (5.2)	7 (3.2)	19 (4.2)
Widowed	9 (3.9)	3(1.4)	12 (2.7)
Educational Status			
Diploma	29 (12.6)	30 (13.6)	59 (13.1)
First degree	187 (81.3)	164 (74.5)	351 (78.0)
2nd degree and above	14 (6.1)	26 (11.9)	40 (8.9)
Professional category			
Gen. and obstetrician	4 (1.7)	5 (2.3)	9 (2.0)
Internist	3 (1.3)	7 (3.2)	10 (2.2)
Pediatrician	3 (1.3)	7 (3.2)	10 (2.2)
Surgeon	4 (1.7)	7 (3.2)	11 (2.5)
Anesthetist	7 (3.1)	17 (7.7)	24 (5.4)
HO	8 (3.5)	22 (10.0)	30 (6.7)
Lab personnel	19 (8.3)	26 (11.8)	45 (10.0)
GP	25 (10.9)	23 (10.4)	48 (10.6))
Midwife	34 (14.8)	29 (13.2)	63 (14.0)
Nurse	123 (53.4)	77 (35.0)	200 (44.4)

(*Continued*)

Table 2 (Continued).

Characteristics	Public Hospitals (n=230) No (%)	Private Hospitals (n=220) No (%)	Total (n=450) No (%)
Department			
Emergency unit	30 (13.0)	31 (14.1)	61 (13.6)
Pediatric ward	31 (13.5)	24 (10.9)	55 (12.2)
Maternity ward	39 (16.9)	36 (16.4)	75 (16.7)
Medical ward	42 (18.3)	35 (15.9)	77 (17.1)
Surgical ward	34 (14.8)	40 (18.2)	74 (16.4)
Laboratory unit	19 (8.3)	26 (11.8)	45 (10.0)
OPD	35 (15.2)	28 (12.7)	63 (14.0)
Service in years			
≤5	91 (39.6)	161 (73.2)	252 (56.0)
6–10	96 (41.7)	33 (15.0)	129 (28.7)
≥10	43 (18.7)	26 (11.8)	69 (15.3)
Total hours working per week			
≤39	105 (45.6)	99 (45.0)	204 (45.3)
>39	125 (54.4)	121 (55.0)	246 (54.7)
Monthly income in ETB			
<5000	24 (10.4)	34 (15.4)	58 (12.9)
5000–7000	134 (58.3)	115 (52.3)	249 (55.3)
≥7000	72 (31.3)	71 (32.3)	143 (31.8)
Monthly risk allowance			
Yes	106 (46.1)	0	106 (23.6)
No	124 (53.9)	220 (100)	344 (76.4)
Monthly risk allowance in ETB			
<500	92 (86.8)	0	92 (86.8)
≥500	14 (13.2)	0	14 (13.2)

Abbreviations: CS, comprehensive specialized, OPD, outpatient department ETB, Ethiopian Birr.

Knowledge of HCWs on Standard Precautions

Regarding the knowledge of HCWs on standard precautions, from the total score of 8 correct answers the mean knowledge score for the overall adherence was 5.78 (standard deviation (SD) ±2.5), while the mean knowledge score for public and private hospitals was 5.78 (SD ± 2.6) and 5.77 (SD ± 2.3), respectively. More than two-thirds of HCWs 66.7% (95% (CI): 62.3–71.0) had good knowledge of standard precautions. From a total of 230 participants in public hospitals, 67.4% (95% CI: 61.3–73.5) had good knowledge of standard precautions. From a total of 220 participants in private hospitals, 65.9% (95% CI: 59.6–72.2) had good knowledge of standard precautions.

Attitude of Healthcare Workers on Standard Precautions

Regarding healthcare workers' attitudes toward adhering to standard precautions, the median attitude score for overall adherence to SPs was 40 (interquartile range: 34–45). In public hospitals, the median attitude score was 39 (IQR: 33–43), while in private hospitals, it was 41 (IQR: 35–48). Out of 450 study participants, 66.9% (95% CI: 62.5–71.2) demonstrated a favorable attitude toward standard precautions. Specifically, among 230 participants in public hospitals, 70.0% (95% CI: 64.0–75.9) showed a favorable attitude, whereas among 220 participants in private hospitals, 61.8% (95% CI: 55.3–68.3) exhibited a favorable attitude toward standard precautions.

Health Institution-Related Factors

Out of 450 participants in the study, 233 (51.8%) indicated having access to written IP guidelines in their workspaces. Additionally, 61.3% reported having running tap water, 56.7% had adequate personal protective equipment (PPE), and 71.1% had sharp material containers available. Training on Standard precautions was received by only 209 (46.4%) of the respondents.

In public hospitals, 122 (53%) respondents mentioned having written guidelines in their working rooms, while in private hospitals, 111 (50.4%) reported the same. Furthermore, in public hospitals, 45.2% had access to running tap water, 33% had adequate PPE, and 74.4% had color-coded dust bins available in their working rooms (Table 3).

Table 3 Frequency Distribution of Health Institution-Related Characteristics Among HCWs at Public and Private Hospitals in Dessie City, Ethiopia, April 2021 (n=450)

Variables	Public hospitals (n=230) No (%)	Private hospitals (n=220) No (%)	Total (n=450) No (%)	X2	P-value
Availability of written guidelines					
Yes	122 (53.0)	111 (50.4)	233 (51.8)	0.30	0.583
No	108 (47.0)	109 (49.6)	217 (48.2)		
Availability of running tape water					
Yes	104 (45.2)	172 (78.2)	276 (61.3)	51.5*	0.000
No	126 (54.8)	48 (21.8)	174 (38.7)		
Adequacy of PPE					
Yes	76 (33.0)	179 (81.4)	255 (56.7)	106.9*	0.000
No	154 (67)	41 (18.6)	195 (43.3)		
Availability of safety box					
Yes	155 (67.4)	165 (75.0)	320 (71.1)	3.17	0.075
No	75 (32.6)	55 (25)	130 (28.9)		
Availability of color-coded dust bins					
Yes	171 (74.4)	180 (81.8)	351 (78.0)	3.65	0.056
No	59 (25.6)	40 (18.2)	99 (22)		
Training on standard precautions					
Yes	105 (45.6)	104 (47.3)	209 (46.4)	0.12	0.730
No	125 (54.4)	116 (52.7)	241 (53.6)		

(*Continued*)

Table 3 (Continued).

Variables	Public hospitals (n=230) No (%)	Private hospitals (n=220) No (%)	Total (n=450) No (%)	X2	P-value
Training on standard precautions upon hire					
Yes	56 (24.4)	81 (36.8)	137 (30.4)	8.26*	0.004
No	174 (75.6)	139 (63.2)	313 (69.6)		
Encouragement by hospital management					
Yes	64 (27.8)	82 (37.3)	146 (32.4)	4.58*	0.032
No	166 (72.2)	138 (62.7)	304 (67.6)		
Availability of infection prevention committee					
Yes	213 (92.6)	217 (98.6)	430 (95.6)	9.62*	0.002
No	17 (7.4)	3 (1.4)	20 (4.4)		
Monitoring and evaluation of standard precautions					
Yes	75 (32.6)	96 (43.6)	171 (38.0)	5.80*	0.016
No	155 (67.4)	124 (56.4)	279 (62.0)		

Notes: Adequacy implies the availability of Glove, goggles, masks, and apron in the working room [Encouragement includes regular supportive supervision and providing feedback or rewarding recognition for practice of standard precautions or all] *indicates significant differences.

Adherence to Standard Precautions

Hand Hygiene Adherence

The magnitude of overall hand hygiene adherence among healthcare workers working at hospitals in Dessie City was 52.3% (95% CI: 47.5–56.8). Also, the magnitude of adherence at the public hospitals was 52.2% (95% CI: 45.6–58.6), whereas the magnitude of adherence at the private hospitals was 50.9% (95% CI: 44.2–57.5). According to this study, from a total of 450 study participants 79 (17.6%) and 214 (47.6%) always wash hands before touching a patient and clean/aseptic procedures, respectively. Two hundred thirty-three (51.7%) and 316 (70.2%) always wash hands after touching patient and body fluid exposure, respectively. One hundred thirty-six (59.1%) in public and 183 (83.2%) respondents in private hospitals reported that they always perform hand rubbing with an alcohol-based preparation (Table 4).

Table 4 Adherence to Hand Hygiene Practice Among Health Care Workers at Public and Private Hospitals in Dessie City, Ethiopia, April 2021 (n=450)

Adherence Variables	Public Hospitals (n=230) No (%)			Private Hospitals (n=220) No (%)			Total (n=450) No (%)		
Response	N	S	A	N	S	A	N	S	A
Washing hands before touching a patient	142 (61.7)	48 (20.9)	40 (17.4)	98 (44.6)	83 (37.7)	39 (17.7)	240 (53.3)	131 (29.1)	79 (17.6)
Washing hands before cleaning /aseptic procedures	64 (27.8)	66 (28.7)	100 (43.5)	45 (20.5)	61 (27.7)	114 (51.8)	109 (24.2)	127 (28.2)	214 (47.6)

(*Continued*)

Table 4 (Continued).

Adherence Variables	Public Hospitals (n=230) No (%)			Private Hospitals (n=220) No (%)			Total (n=450) No (%)		
Washing hands after touching a patient	69 (30.0)	62 (27.0)	99 (43.0)	24 (10.9)	62 (28.2)	134 (60.9)	93 (20.6)	124 (27.5)	233 (51.7)
Washing hands after touching body fluid exposures	31 (13.5)	38 (16.5)	161 (70.0)	9 (4.0)	56 (25.5)	155 (70.5)	40 (8.8)	94 (20.8)	316 (70.2)
Washing hands immediately after removal of gloves	55 (23.9)	70 (30.4)	105 (45.7)	56 (25.5)	64 (29.0)	100 (45.5)	111 (24.6)	134 (29.8)	205 (45.6)
Washing hands between patient contact	128 (55.6)	59 (25.7)	43 (18.7)	57 (26.0)	87 (39.5)	76 (34.5)	185 (41.1)	146 (32.5)	119 (26.4)
Washing hands after touching the patient's surroundings	131 (57.0)	51 (22.2)	48 (20.8)	104 (47.3)	55 (25.0)	61 (27.7)	235 (52.2)	106 (23.6)	109 (24.2)
Washing hands with antiseptic-containing soap and water	65 (28.3)	65 (28.3)	100 (43.4)	16 (7.3)	83 (37.7)	121 (55.0)	81 (18.0)	148 (32.9)	221 (49.1)
Performing hand-rubbing with an alcohol-based preparation	30 (13.1)	64 (27.8)	136 (59.1)	5 (2.3)	32 (14.5)	183 (83.2)	35 (7.8)	96 (21.3)	319 (70.9)

Adherence to Personal Protective Standard Precautions

The magnitude of overall PPE utilization adherence among healthcare workers working at hospitals in Dessie City was 55.8% (95% CI: 51.2–60.3). Also, the magnitude of adherence among the public hospitals was 53.5% (95% CI: 46.9–59.9), whereas the magnitude of adherence at the private hospitals was 58.6% (95% CI: 52.1–65.1). From a total of 450 participants, 240 (53.3%) and 149 (33.1%) reported that they always protect themselves against the body fluids of all patients regardless of their diagnosis and provide care considering all patients as potentially infectious, respectively. Among the respondents in public hospitals 21.3%, 19.6%, and 23.5% reported that they always wore eye goggles, plastic apron, and boots whenever indicated, respectively. When we come to private hospitals, only 23.2%, 31.8%, and 38.6% of respondents reported that they always wear eye goggles, plastic aprons, and boots whenever indicated, respectively. The majority of respondents both in public (83.9%) and private hospitals (84.5%) reported that they always wear masks (Table 5).

Table 5 Adherence to Personal Protective Precautions Among Health Care Workers at Public and Private Hospitals in Dessie City, Ethiopia, April 2021 (n=450)

Adherence Variables	Public Hospitals (n=230) No (%)			Private Hospitals (n=220) No (%)			Total (n=450) No (%)		
Response	N	S	A	N	S	A	N	S	A
Protecting myself fluids of all patients regardless of their diagnosis	43 (18.7)	76 (33.0)	111 (48.3)	17 (7.7)	74 (33.6)	129 (58.6)	60 (13.4)	150 (33.3)	240 (53.3)
Providing care considering all as potentially infectious	98 (42.6)	75 (32.6)	57 (24.8)	55 (25.0)	73 (33.2)	92 (41.8)	153 (34.0)	148 (32.9)	149 (33.1)
Avoid wearing my gown out of the workplace	27 (11.7)	57 (24.8)	146 (63.5)	20 (9.1)	78 (35.4)	122 (55.5)	47 (10.4)	135 (30.0)	268 (59.6)
Wearing gloves during contact with any body fluids or blood and mucous membranes	18 (7.8)	53 (23.1)	159 (69.1)	17 (7.8)	63 (28.6)	140 (63.6)	35 (7.8)	116 (25.8)	299 (66.4)

(*Continued*)

Table 5 (Continued).

Adherence Variables	Public Hospitals (n=230) No (%)			Private Hospitals (n=220) No (%)			Total (n=450) No (%)		
Changing gloves between contacts with different patients	10 (4.4)	59 (25.6)	161 (70.0)	0	51 (23.2)	169 (76.8)	10 (2.3)	110 (24.4)	330 (73.3)
Wearing a mask when indicated	10 (4.4)	27 (11.7)	193 (83.9)	3 (1.4)	31 (14.1)	186 (84.5)	13 (2.9)	58 (12.9)	379 (84.2)
Wearing eye goggles when indicated	121 (52.6)	60 (26.1)	49 (21.3)	69 (31.4)	100 (45.4)	51 (23.2)	190 (42.2)	160 (35.6)	100 (22.2)
Wearing a plastic apron when indicated	127 (55.2)	58 (25.2)	45 (19.6)	66 (30.0)	84 (38.2)	70 (31.8)	193 (42.8)	142 (31.6)	115 (25.6)
Wearing rubber boots/overshoes when indicated	114 (49.6)	62 (26.9)	54 (23.5)	60 (27.3)	75 (34.1)	85 (38.6)	174 (38.7)	137 (30.5)	139 (30.8)

Abbreviations: N, Never, S, Sometimes, A, Always.

Adherence to Safe Injection Practice

The magnitude of overall injection safety adherence among healthcare workers working at hospitals in Dessie City was 68.4% (95% CI: 64.1–72.7). Also, the magnitude of adherence at the public hospitals was 63% (95% CI: 56.7–69.3), whereas the magnitude of adherence at the private hospitals was 74.1% (95% CI: 68.2–79.9). The majority of respondents both in public (80.4%) and private hospitals (78.2%) reported that they always avoid removing used needles from disposable syringes.

Adherence to Instrument Processing and Waste Management

The magnitude of overall instrument processing and waste management among healthcare workers working at hospitals in Dessie City was 66% (95% CI: 61.6–70.4). Also, the magnitude of adherence at the public hospitals was 63.5% (95% CI: 57.2–69.7), whereas the magnitude of adherence at the private hospitals was 52.7% (95% CI: 46.1–59.4). From a total of 450 study participants, 287 (63.8%) and 272 (60.4%) reported that they always used sterilized reusable equipment and disinfected environmental surfaces, respectively. The majority of respondents in public (86.1%) and private hospitals (80.9%) reported that they always dispose of used needles and syringes immediately in a safety box.

Observation

The hospitals were observed before introducing the questionnaire to the participants. An average of 2–3 days was spent in each institution to observe a total of 317 (161 in public hospitals and 156 in private hospitals) working rooms which included the emergency unit, inpatient service (medical, surgical, pediatrics, gynecology, and maternity/labor wards), an operation unit, laboratory unit, outpatient department, injection, and dressing rooms. During Observation, all hospitals had tap water which was connected to the main supply of the local water system. However, from a total of 317 observed units in all hospitals, only 234 (73.8%) had running tap water in their working rooms, while soap was available only in 183 (57.7%) of observed rooms specifically in the operation room, maternity/labor room, laboratory unit and outpatient department of each hospital. Almost all (97.5%) of the observed rooms had alcohol-based preparation for hand rubbing.

Regarding PPE availability, during observation, gloves (surgical and disposable) and masks were available in 284 (89.6%) and 281 (88.6%) working rooms, respectively, while goggles, plastic aprons, caps, and rubber boots were available in maternity/labor and operation rooms which account only 43 (13.6%) among the total observed rooms. The sterilization technique was steam and instruments were clearly labeled with date in all observed rooms. Almost in all (98.7%) observed rooms health care providers decontaminate medical instruments/equipment immediately after use, while in 7 (2.21%) of observed emergency unit working rooms in public hospitals (Dessie Comprehensive Specialized Hospital) there is a chance of recontamination of the instrument.

Further observation was made at each labor ward of each hospital and all delivery coaches were decontaminated after delivery was conducted. Regarding needles and sharp material disposal, 305 (96.2%) of the observed clinical working rooms had safety boxes with international biohazard symbols. However, among the observed safety boxes in working rooms 96 (31.5%), 121 (39.7%), and 23 (17.5%) were overfilled, and empty syringes with needles were seen through the hole, respectively. Sixty-five (21.3%) of the observed safety boxes were filled at three-fourths. Among the total observed rooms, blood was observed on the ground at 3 emergency unit working rooms in a public hospital (Dessie Comprehensive Specialized Hospital). On the other side, there were no observed used needles, or sharp materials on the ground and surrounding the observed unit/room. In addition, the healthcare worker does not leave the needle on the septum/stopper of the multi-dose vial. The majority of observed rooms 284 (89.6%) had separate (color-coded) bins/containers used for segregating waste into infectious and non-infectious waste, while only 194 (61.2) of rooms had waste collection containers located closer to the work area.

From a total of 161 observed units in public hospitals, only 78 (48.4%) had running tap water in their working rooms, while soap was available only in 74 (46%) of the observed rooms. Regarding PPE availability, during observation gloves (surgical and disposable) and masks were available in 128 (79.5%) and 125 (77.6%) working rooms, respectively, while goggles, plastic aprons, caps, and rubber boots were available in maternity/labor and operation rooms which account only 18 (11.2%) among the total observed rooms in public hospitals. Regarding needles and sharp material disposal, 155 (96.3%) of the observed clinical working rooms had safety boxes with international biohazard symbols. The majority (48.4%) of observed safety boxes were overfilled.

From a total of 156 observed units in private hospitals majority 109 (69.8%) had soap in their working rooms, while all rooms had running tap water. Regarding PPE availability, during observation gloves (surgical and disposable) and masks were available in all of the working rooms, while goggles, plastic aprons, caps, and rubber boots were available in maternity/labor and operation rooms, which accounts for only 25 (16%) among the total observed rooms in private hospitals. Regarding needles and sharp material disposal, 150 (96.2%) of the observed clinical working rooms had safety boxes with international biohazard symbols. The majority (60%) of observed safety boxes were empty while no one was torn.

The Magnitude of Standard Precaution Adherence

The magnitude of overall standard precaution adherence among healthcare workers working at hospitals in Dessie City was 51.6% (95% CI: 46.9–56.2). The magnitude of adherence among healthcare workers working at the public hospitals in Dessie City was 52.2% (95% CI: 45.6–58.6), whereas the magnitude of adherence among healthcare workers working at the private hospitals in Dessie City was 60.4% (95% CI: 53.9–66.9).

Factor Analysis

We have fitted three different models to assess factors associated with standard precaution adherence of healthcare workers. The first and the second models were fitted to assess factors associated with standard precaution adherence of health care workers at public and private hospitals, respectively. The third model was fitted to assess factors associated with the overall standard precaution adherence of healthcare workers.

Factors Associated with Standard Precaution Adherence in Public Hospitals

The binary logistic regression analysis was conducted to ensure multicollinearity and model fitness, as evidenced by satisfying the Hosmer–Lemeshow test with a p-value greater than 0.05. The analysis aimed to identify factors associated with healthcare workers' adherence to standard precautions. Out of the initial 24 variables assessed through bivariate analysis, 8 were selected based on a significance level of p-value less than 0.2 for inclusion in the multivariable analysis model. Subsequently, four variables emerged as statistically significant factors associated with adherence to standard precautions ($p < 0.05$) after adjusting for confounders. These significant variables were sex, availability of written guidelines, knowledge, and attitude of healthcare workers toward standard precaution practices. In this study, female healthcare workers demonstrated a 2.58-fold higher likelihood of adhering to standard precautions compared to male healthcare workers (Adjusted Odds Ratio [AOR]: 2.58; 95% Confidence Interval [CI]: 1.32–5.02). Healthcare workers whose workrooms had written guidelines were 3.1 times more likely to adhere to standard precautions (AOR: 3.10; 95%

CI: 1.62–5.94) compared to those without available written guidelines. Similarly, healthcare workers with good knowledge of standard precautions exhibited a 2.05-fold higher likelihood of adherence (AOR: 2.05; 95% CI: 1.03–4.11) compared to those with poor knowledge. Furthermore, healthcare workers with a favorable attitude toward standard precautions were 2.21 times more likely to adhere (AOR: 2.21; 95% CI: 1.14–4.27) compared to those with an unfavorable attitude.

Factors Associated with Standard Precaution Adherence in Private Hospitals

A binary logistic regression analysis was conducted to examine factors associated with healthcare workers' adherence to standard precautions. Out of 21 variables evaluated through bivariate analysis, 7 were selected based on a significance level of p-value less than 0.2 for inclusion in the multivariable analysis model. Consequently, five variables were identified as statistically associated with adherence to standard precautions ($p < 0.05$) after adjusting for confounders. These significant variables included the availability of running tap water, personal protective equipment (PPE), color-coded dust bins, knowledge, and attitude of healthcare workers toward standard precaution practices.

Healthcare workers whose workrooms had running tap water were 2.36 times more likely to adhere to standard precautions (Adjusted Odds Ratio [AOR]: 2.36; 95% Confidence Interval [CI]: 1.10–5.04) compared to those without access to running tap water. Similarly, healthcare workers with adequate PPE in their workrooms exhibited a 2.22-fold higher likelihood of adherence (AOR: 2.22; 95% CI: 1.01–4.93) compared to those without adequate PPE. Furthermore, healthcare workers with access to color-coded dust bins in their workrooms showed a 2.33-fold higher likelihood of adherence (AOR: 2.33; 95% CI: 1.04–5.21) compared to those without such bins. Additionally, healthcare workers with good knowledge of standard precautions demonstrated a 2.1-fold higher likelihood of adherence (AOR: 2.10; 95% CI: 1.07–4.13) compared to those with poor knowledge. Lastly, healthcare workers with a favorable attitude toward standard precautions were 2.63 times more likely to adhere (AOR: 2.63; 95% CI: 1.39–4.97) compared to those with an unfavorable attitude.

Factors Associated with the Overall Standard Precaution Adherence in Public and Private Hospitals

A binary logistic regression analysis was conducted to explore factors associated with healthcare workers' adherence to standard precautions. Out of 25 variables examined through bivariate analysis, 11 were selected based on a significance level of p-value less than 0.2 for inclusion in the multivariable analysis model. Consequently, five variables were identified as statistically associated with adherence to standard precautions ($p < 0.05$) after adjusting for confounders. These significant variables included sex, workplace, availability of written guidelines, knowledge, and attitude of healthcare workers toward standard precaution practices.

In this study, female healthcare workers exhibited a 1.9-fold higher likelihood of adhering to standard precautions compared to male healthcare workers (Adjusted Odds Ratio [AOR]: 1.90; 95% Confidence Interval [CI]: 1.20–3.02). Healthcare workers employed in private hospitals were 5.72 times more likely to adhere to standard precautions (AOR: 5.72; 95% CI: 2.72–12.0) compared to those in public hospitals. Similarly, healthcare workers whose workrooms had written guidelines demonstrated a 2.14-fold higher likelihood of adherence (AOR: 2.14; 95% CI: 1.34–3.41) compared to those without access to written guidelines. Additionally, healthcare workers with a good knowledge of standard precautions showed a 3.49-fold higher likelihood of adherence (AOR: 3.49; 95% CI: 2.09–5.83) compared to those with poor knowledge. Furthermore, healthcare workers with a favorable attitude toward standard precautions were 2.28 times more likely to adhere (AOR: 2.27; 95% CI: 1.43–3.66) compared to those with an unfavorable attitude (Table 6).

Discussion

The study findings revealed that the overall adherence to standard precautions among HCWs was only 51.6% (95% CI: 46.9–56.2). The result of this study also showed that the magnitude of adherence among healthcare workers working at the public and private hospitals in Dessie City was 52.2% (95% CI: 45.6–58.6) and 60.4% (95% CI: 53.9–66.9),

Table 6 Bivariable and Multivariable Analysis of Factors Associated with the Overall Standard Precaution Adherence, Hospitals in Dessie City, April 2021 (n=450)

Variables	Adherence public hospital (n=230)		Adherence private hospital (n=220)		Adherence overall (n=450)		COR (95% CI)	AOR (95% CI)
	Good No(%)	Poor No(%)	Good No(%)	Poor No(%)	Good No(%)	Poor No(%)		
Sex								
Female	75(62.5)	37(33.6)	69(51.9)	48(55.2)	137(59.0)	92(42.2)	1.97(1.35, 2.87)	11.90(1.20,3.02)**
Male	45(37.5)	73(66.4)	64(48.1)	39(44.8)	95(41.0)	126(51.8)	1	1
Marital status								
Married	88(73.3)	52(47.3)	86(64.7)	49(56.3)	156(67.2)	118(54.1)	1.73(1.18, 254)	1.54(0.96, 2.49)
Unmarried	32(26.7)	58(52.7)	47(35.3)	38(43.7)	76(32.8)	100(45.9)	1	1
Work experience								
≤5	41(34.2)	50(45.5)	104(78.1)	57(65.5)	143(61.6)	109(50.0)	2.80(1.59, 4.92)	1.17(0.59, 2.33)
6–9	62(51.6)	33(30.0)	19(14.3)	14(16.1)	67(28.9)	62(28.4)	2.30(1.25, 4.26)	1.13(0.52, 2.43)
≥10	17(14.2)	27(24.5)	10(7.6)	16(18.4)	22(9.5)	47(21.6)	1	1
Level of Hospital								
General	35(29.2)	35(31.8)	133(100)	87(100)	169(72.8)	121(55.5)	2.15(1.45, 3.18)	0.53(0.26, 1.10)
C.Specialized	85(70.8)	75(68.2)	0	0	63(27.2)	97(44.5)	1	1
Workplace								
Private hospital	0	0	133(100)	87(100)	150(64.6)	70(32.1)	3.86(2.61, 572)	5.72(2.72, 12.0)***
Public hospital	120(100)	110(100)	0	0	82(35.4)	148(67.9)	1	1
Availability of written guidelines								
Yes	82(68.4)	40(36.4)	67(50.4)	44(50.6)	138(59.5)	95(43.6)	1.90(1.3, 2.76)	2.14(1.34, 3.41)
No	38(31.6)	70(63.6)	66(49.6)	43(49.4)	94(40.5)	123(56.4)	1	1
Availability of running tap water								
Yes	53(44.2)	51(46.4)	116(87.2)	56(64.4)	165(71.1)	111(50.9)	2.37(1.60, 3.50)	150(0.91, 2.45)
No	67(55.8)	59(53.6)	17(12.8)	31(35.6)	67(28.9)	107(49.1)	1	1
Availability of personal protective equipment								
Yes	37(30.8)	39(35.5)	117(88.0)	62(71.3)	156(67.2)	99(45.4)	2.46(1.68, 3.61)	1.36(0.81, 2.28)
No	83(69.2)	71(64.5)	16(12.0)	25(28.7)	76(32.8)	119(54.6)	1	1
Received training								
Yes	65(54.2)	40(36.4)	61(45.9)	43(49.4)	120(51.7)	89(40.8)	1.55(1.06, 2.25)	1.11(0.69, 1.77)
No	55(45.8)	70(63.6)	72(54.1)	44(50.6)	112(48.3)	129(59.2)	1	1

(*Continued*)

Table 6 (Continued).

Variables	Adherence public hospital (n=230)		Adherence private hospital (n=220)		Adherence overall (n=450)		COR (95% CI)	AOR (95% CI)
	Good No(%)	Poor No(%)	Good No(%)	Poor No(%)	Good No(%)	Poor No(%)		
Knowledge								
Good	97(80.8)	57(51.8)	104(78.2)	41(47.1)	187(80.6)	113(51.8)	3.86(2.53, 5.87)	3.49(2.09, 5.83)***
Poor	23(19.2)	53(48.2)	29(21.8)	46(52.9)	45(19.4)	105(48.2)	1	1
Attitude								
Favorable	101(84.2)	60(54.5)	99(74.4)	37(42.5)	187(80.6)	114(52.3)	3.48(2.35, 5.13)	2.28(1.43,3.66)***
Unfavorable	19(15.8)	50(45.5)	34(25.6)	50(57.5)	45(19.4)	104(47.7)	1	1

Notes: C-comprehensive, **significant at p-value <0.01, ***significant at p-value<0.001. Hosmer and Lemshow's goodness of fit test was 0.503 hence the model adequately fits the data. The test of VIF was 3.29 ie, <10. No multicollinearity problem between factors.

respectively. The result of this study showed that standard precaution adherence among public and private HCWs had a statistically significant difference (X^2 = 47.6, p-value<0.001).

In this study, the overall adherence was nearly similar to a study done in the Dawuro zone which was 54% and low when compared with a study conducted in Addis Ababa, Debre Markos, and Hawassa, which were 66.1%, 57.3%, and 56.5%, respectively.[16,24,30] However, it was high when compared with the Mekelle zone, Bale zone, and the University of Gondar Comprehensive Specialized Hospital, which were 42.9%, 39.9%, and 12%, respectively.[12,13] Differences in adherence could be due to differences in the type and level of health care facilities from which HCWs were selected, study design, sampling technique, study setting such as variations in availability of personal protective equipment and safety materials, and HCW's experiences and professions. In addition, the differences in adherence rates could stem from variations in healthcare infrastructure, resource allocation, training programs, and cultural factors among regions and healthcare facilities, influencing healthcare workers' adherence to standard precautions.

The present study compared adherence to standard precautions among HCWs between public and private hospitals in Dessie City. Accordingly, the magnitude of adherence in this study indicates the remarkable difference between public and private HCWs in which there is better adherence among private hospital HCWs (60.4%) than public hospital HCWs (52.2%). This difference might be due to the adequate availability of equipment (PPE, running tape water, color-coded dust bins) and supplies in private hospitals to public hospitals. In addition, the low workload in private hospitals may enable HCWs to more adhere to standard precautions. This study is different from a study done in Nigeria where public hospital HCWs (65%) were more adhered to than private hospital HCWs (53.3%).[31] The difference might be attributed to the difference in sample size, the type, and level of healthcare facilities from which HCWs selected, differences in academic background, HCW's attitude, and study setting.

According to this study, the magnitude of hand hygiene adherence at public 52.2% (95% CI: 45.6–58.6) and private hospitals 50.9% (95% CI: 44.2–57.5) was nearly similar. This was consistent with a finding in Addis Ababa at 50.6%, but lower as compared to a study done in the Dawuro zone where the magnitude of hand hygiene adherence was 58%.[17,] Discrepancies in hand hygiene adherence rates between public and private hospitals could be attributed to similarities in healthcare settings but might also reflect varying institutional protocols, resource availability, and cultural influences on hygiene practices across different regions and facilities. Furthermore, when each of the specific items of hand hygiene adherence was analyzed the relatively lower proportion of HCWs in public hospitals (43.5%) were always washing their hands before clean/aseptic procedures as compared to private hospitals (51.8%). Moreover, only 43.0% of HCWs in public hospitals were always washing their hands after touching a patient, while in private it was 60.9%. These slight differences between public and private hospitals might be due to variations in the availability of hand-washing facilities and continuous running tap water in the health facility. This possible justification is also supported by observation done

where 48.4% and 100% of working rooms had running tap water in public and private hospitals, respectively. However, this finding was contrary to a study done in Nigeria where 85% of respondents in public hospitals and only 70% of respondents in private hospitals reported that they always washed their hands after touching a patient. This variation might be due to differences in the study setting. According to the study, HCWs always washing hands with antiseptic-containing soap were only 43.4% in public hospitals, while in private it was 55%. It was relatively higher as compared to public hospitals. This variation might be due to better availability of soap in private than public hospitals. This possible reason was supported by the observation done in which 46% of working rooms in public hospitals and 69.8% in private hospitals had soap for hand washing.

According to this study, the magnitude of PPE utilization adherence at public hospitals 53.5% (95% CI: 46.9–59.9) was relatively lower than at private hospitals 58.6% (95% CI: 52.1–65.1). This finding was lower as compared to a study done in the Dawuro zone where PPE utilization adherence was 87.2%.[17] This difference might be due to variations in study settings and the availability of personal protective equipment.

According to this study, HCWs who always wore eye google, plastic aprons, and rubber boots when there was the possibility of a splash of blood or body fluid in public hospitals were found to be very low, which were 21.3%, 19.6%, and 23.5%, respectively. Similarly, in private hospitals, HCWs who always wore goggles, plastic aprons, and rubber boots whenever necessary were 23.2%, 31.8%, and 38.6%, respectively. A relatively similar finding was also observed in a comparative study in Nigeria where (45%, 64%, and 5%) of HCWs in public hospitals and (28%,40%, and 15%) of HCWs in private hospitals were always wearing rubber boots, plastic apron, and eye googles, respectively.[31] Another similar finding was also reported in many studies conducted in Africa where utilization of the above-mentioned PPEs was found to be low.[14,27,] The possible implications of these findings might be that HCWs working either in public or private hospitals are not protecting themselves, their patients as well the community from communicable infections as recommended per national guidelines.[14,] Furthermore, the lower availability of PPEs (eye goggles, plastic apron, and rubber boots) especially in public hospitals might be an additional reason for lower utilization and this possible reason was supported by observation done in which only 13.6% of working rooms had those mentioned PPEs.

On the other hand, in this study majority of HCWs in public (69.1% and 70%) and private hospitals (63.6% and 76.8%) were always wearing gloves during contact with any body fluids or blood and changing gloves between contacts with different patients, respectively. It is relatively consistent with a comparative study conducted in Nigeria where 81% and 77% of HCWs were always wearing gloves in public and private health facilities, respectively.[31] This similarity might be due to adequate availability of gloves both in public and private hospitals, which is supported by observation done in which 79.5% and 100% availability in working rooms, respectively. In addition, in this study, 83.9% and 84.5% of HCWs were always wearing a mask in public and private hospitals, respectively. This finding was higher as compared to many studies conducted in Ethiopia.[12,24] The possible justification for this could be the emergence of the COVID-19 pandemic which improves awareness of HCWs on SPs and increases availability and accessibility of these supplies. Furthermore, 63.5% and 55.5% of HCWs reported that they always avoid wearing gowns outside hospital compounds in public and private hospitals, respectively. This finding was higher than a study conducted in Gondar where only 37.6% of HCWs reported that they always avoid wearing gowns outside hospital compounds.[13] This difference might be due to variations in obeying organizational policies. Furthermore, this study declared that HCWs always provide care considering all patients as potentially infectious in public hospitals were only 24.8%, whereas in private hospitals it was 41.8%. This was nearly similar to a study conducted in Gondar and Hawassa in which HCWs providing care considering all patients as potentially infectious were 27% and 21.1%, respectively.[13] The possible implication of this finding is that frequent awareness creation campaigns, especially in public hospitals, are essential to make HCWs provide care considering every patient as potential for transmission and acquisition of infectious agent.

There was a significant difference in the magnitude of injection safety adherence between public 63% (95% CI: 56.7–69.3) and private hospitals 74.1% (95% CI: 68.2–79.9). This might be due to better awareness of safe injection practices in private hospitals. This finding was higher than a study conducted in Addis Ababa where the magnitude of safe injection adherence was 52.9%.[41] This difference might be due to variations in HCW's awareness and experiences. However, the majority of health care workers, both in public hospitals (67.4%, 72.6%, and 80.4%) and private hospitals (67.7%, 75.0%, and 75.9%), reported that they never recap needles, bend meddles and remove used needles from

disposable syringes, respectively. A relatively similar finding was also observed in a study done in a tertiary hospital in Nigeria in which 63.6% and 79.4% of HCWs reported that they never recap and bend needles.[32] However, this finding is relatively higher as compared to a study done in private hospitals in the same country where 50.3% of HCWs reported that they never recap used needles.[33] This difference might be due to variations in the academic background of HCWs selected and differences in awareness about standard precautions.

The magnitude of instrument processing and waste management adherence at public hospitals 59.6% (95% CI: 53.2–65.9) was slightly lower than at private hospitals 62.7% (95% CI: 56.2–69.1). This might be due to the better availability of safety materials such as separate color-coded dust bins in private than public hospitals. This is also supported by observation done in which 98.1% and 81.4% of working rooms in private and public hospitals had separate color-coded dust bins, respectively.

In factor analysis, the present study showed that having good knowledge of standard precautions was significantly associated with good adherence to standard precautions in the overall study as well as in public and private hospitals. Healthcare workers who had good knowledge of standard precautions were 2.05, 2.1, and 3.49 times more likely to have good adherence to standard precautions compared to those who had poor knowledge in public, and private hospitals and in overall adherence, respectively. This finding agreed with studies done in Bale Zone, East Arsi Zone, Addis Ababa, and Nigeria that good knowledge of SP was significantly associated with good practice.[12,15,17,30] The possible implication of this finding is that enhancing the knowledge of HCWs on standard precautions through training and supportive supervision is key to improving adherence to standard precautions in healthcare settings.[14,]

According to this study, the favorable attitude had a significant association with good adherence in the overall study as well as public and private hospitals. HCWs who had favorable attitudes toward standard precautions were 2.21, 2.63, and 2.28 times more likely to have good adherence to standard precautions compared to those who had unfavorable attitudes in public, and private hospitals and overall adherence, respectively. Another similar finding was also reported in many studies.[12,15,30] Among these, a study was done in the East Arsi zone, Ethiopia, in which favorable attitude HCWs were 2.42 times more likely to be adhered to than unfavorable attitude HCWs.[15] This finding could be explained by the fact that whenever HCWs had a high-risk perception and favorable attitude towards safety measures they were more likely to be adhered to.[15,16] According to this study, availability of written guidelines was significantly associated with good adherence both in public hospitals and in the overall study. HCWs working in rooms having written guidelines were more likely to be adhered to as compared to those HCWs working in rooms that had no written guidelines. Another similar finding was also reported in many studies.[12,21] The possible implication of this finding is that distributing up-to-date written infection prevention guidelines in working rooms is vital in improving standard precaution adherence.[21]

In this study, availability of running tape water in working rooms had been significantly associated with good standard precaution adherence in private hospitals. Another similar finding was also reported in many studies.[27,] This could be because a continuous water supply is needed for each practice of standard precautions such as hand washing, instrument processing, and waste management. According to this study, those HCWs in private hospitals working in rooms having adequate PPE were 2.22 times more likely to be adhered to as compared to those HCWs working in rooms that had no adequate PPE. It was consistent with a study done in the Dawuro zone where the availability of adequate PPE was significantly associated with standard precaution adherence (p-value<0.001).[16] The possible implication of this finding is that adequate PPE availability should be maintained in hospitals before its utilization. Also, in this study, those HCWs in private hospitals working in rooms having color-coded dust bins were 2.33 times more likely to be adhered to as compared to those HCWs working in rooms that had no color-coded dust bins. The possible implications of these findings could be securing adequate separate color-coded dust bins in hospitals is mandatory for good standard precaution adherence.

To sharpen the gap with private hospitals, programs aiming at encouraging the use of standard precautions should be created and implemented at public hospitals.

Strength and Limitation

This study was a comparative study among public and private hospitals, so it helps to identify the difference in magnitude and associated factors among the two categories of facilities. The data collection was supported by an observational

checklist. However, the possibility of respondent's bias that they were likely to over-report or under-report their practice can be a threat since the study was based on self-reported data.

Conclusion and Recommendations

The adherence to standard precautions was higher among private than public hospital healthcare workers in Dessie City, Ethiopia. As a result, it is recommended to ensure adequate availability of personal protective equipment, safety materials, and running tap water in working rooms, particularly in public hospitals. To enhance adherence to standard precautions among healthcare workers in Dessie City, Ethiopia, it is imperative to prioritize the provision of adequate personal protective equipment, safety materials, and running tap water, particularly within public hospital settings.

Abbreviations

AIDS, Acquired Immune Deficiency Syndrome; AOR, Adjusted Odds Ratio; BSI, Body Substance Isolation; DC, Communicable Disease Control; OR, Crude Odds Ratio; CSA, Central Statistics Agency; HBV, Hepatitis B Virus; HCC, Health Care Facilities; HCV, Hepatitis C Virus; HCC, Health Care Workers; HIV, Human Immune Deficiency Virus; IP, Infection Prevention; NSI, Needle Stick Injury; OPD, Out Patient Department; PPE, Personal Protective Equipment; SPs, Standard Precautions; SPPs, Standard Precaution Practices; WHO, World Health Organization.

Data Sharing Statement

All the necessary data are included in the manuscript. An English version data collection tool and detailed operational definitions of the outcome variable are accessible at a reasonable request from the corresponding author.

Ethical Approval and Consent to Participate

Ethical approval was obtained from the Institutional Review Board of the School of Public Health, College of Medicine and Health Sciences at Wollo University. After explaining the purpose of the study, written informed consent was obtained from participants before data collection. They were informed that participating in the study was voluntary and their right to withdraw from the study at any time during the interview was assured. For this purpose, a one-page consent letter was attached as a cover page of each questionnaire stating the general objective of the study and issues of confidentiality. All methods and materials were performed according to the guidelines.

Acknowledgments

We are grateful to thank Wollo University, the College of Medicine, and the Health Sciences Ethical Review Committee. Also, we want to gratify study participants and data collectors.

Funding

This investigation received no specific grant from a funding agency in the public commercial or for-profit sectors.

Disclosure

The authors declared that they have no competing interests.

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