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KNOWLEDGE OF INFECTION PREVENTION AND CONTROL AMONG HEALTHCARE WORKERS

Nursing

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ABSTRACT

Background: Healthcare-acquired infections (HCAIs), often referred to as nosocomial infections, contribute to higher morbidity and mortality rates in hospitalized patients and elevate the risk of infections among healthcare workers (HCWs). The risk of hospital-acquired infections continues to be a concern, even with advancements in the healthcare system. Insufficient knowledge of infection control practices among healthcare workers leads to lower adherence to these protocols. We conducted a study to evaluate the understanding of infection control measures among nursing professionals at our hospital. **Methods:** A total of 100 nurses working in the intensive and acute care units at our hospital completed a questionnaire containing 20 multiple-choice questions. This included 5 questions each on hand hygiene, standard and transmission-based precautions, care bundles, and general infection control practices. The responses were evaluated and expressed as percentages. **Results:** The study sample consisted of 250 individuals aged 20-60 years, with the majority (40.8%) aged 31-40 years. Females represented 43.2% of the population, while males made up 56.8%. Regarding years of service, 31.2% of respondents had more than 15 years of experience, while 27.2% had 10-15 years, 25.2% had 5-10 years, and 16.4% had less than 5 years of service. Most respondents (58.4%) worked in wards, while 11.2% were in operating theaters (OT), 8.0% in outpatient departments (OPD), and 22.4% in other departments. A significant majority (94.0%) consistently discarded biomedical waste according to guidelines, though 4.8% reported only sometimes following the guidelines. When asked about training for biomedical waste disposal, 51.6% indicated they received training regularly, while 38.8% sometimes received it, and a small percentage (0.8%) never received training. In terms of hand hygiene, 89.6% always washed their hands after patient contact, while 9.6% sometimes did. Additionally, 87.6% always wore gloves when handling blood samples, and 93.6% did so for saliva or sputum samples. Similarly, 92.0% consistently wore gloves when handling patient skin breaches. Regarding the disposal of different types of medical waste, most respondents (88.8%) correctly disposed of surgical blades in white bins, and 64.8% discarded broken ampoules in blue bins. For blood bags, 35.6% used red bins, which aligns with guidelines. Additionally, 74.8% of participants practiced both medical and surgical handwashing. In terms of infection knowledge, 96.0% correctly identified all types of infections (bacterial, viral, fungal, and protozoa), and 92.4% understood that hospital-acquired microorganisms could be transmitted through various routes, including air and droplets. To prevent catheter-associated urinary tract infections (CAUTI), 84.4% of respondents used gloves, while 69.2% indicated masks were appropriate for preventing communicable infections. **Conclusion:** The nurses demonstrated a reasonably good level of knowledge regarding infection control; however, there remains significant room for improvement through ongoing educational programs and in-house training.

KEYWORDS

Awareness, Adherence, Compliance, Control, Factors, Healthcare, Infection, Knowledge, Prevention, Workers

INTRODUCTION:

The necessity for infection control in healthcare facilities arises from the imperative to prevent healthcare-associated infections (HCAIs). HCAIs are defined as infections that occur in a patient during their care in a hospital or other healthcare setting and were not present or incubating at the time of admission. These infections lead to significant morbidity and mortality, longer hospital stays, and higher treatment costs in both developed and resource-limited countries[1].

Healthcare-associated infections (HAIs) pose a significant risk to the safety of both patients and healthcare workers (HCWs), making their prevention a critical priority for healthcare systems and organizations. The prevalence of HAIs among hospitalized patients ranges from 5% to 15%, and they can affect between 9% and 37% of individuals admitted to intensive care units (ICUs) [2-5]. In the United States, at any given time, 1 in every 25 hospitalized patients is impacted by an HAI [1].

In developed countries, the prevalence of healthcare-associated infections (HCAIs) among hospitalized patients is reported to be around 15%, while it can reach as high as 37% for those admitted to intensive care units. In developing nations, the prevalence is somewhat higher, with rates of up to 19% among hospitalized patients [1]. In the United States, the additional costs associated with HCAIs exceed $4.5 billion, and in the United Kingdom, there is a reported mortality rate of 13% along with an average hospital stay that is 2.5 times longer[6-7]. Although data is limited in the Asian part, HCAIs remain a significant cause of preventable morbidity and mortality in developing countries, where infection rates are notably higher due to inadequate infection control measures and overcrowded hospitals [8].

Healthcare-associated infections (HAIs) can lead to a diminished quality of life and even shorten the life expectancy of those affected, while also incurring significant long-term costs [9-10]. For instance, the risk of contracting HAIs from a needle-stick injury with a needle from an infected patient is 0.3% for HIV, 3% for hepatitis C, and between 6% and 30% for hepatitis B [11]. Additionally, HAIs have been linked to serious mental health issues, including anxiety, depression, adjustment disorders, panic attacks, and post-traumatic stress disorder [12].

The abuse and misuse of antibiotics have contributed to the rise of multidrug-resistant organisms, which can be transmitted as healthcare-associated infections (HAIs) [13]. Fortunately, between 55% and 70% of healthcare-associated infections (HAIs) may be preventable [14]. To reduce the risk of HAIs, recommended measures include standard precautions—such as hand hygiene, wearing gloves, gowns, and eye protection, practicing cough etiquette, and the safe disposal of sharp instruments—as well as isolation precautions designed to interrupt the transmission of pathogens (including contact, droplet, and airborne precautions).

To address this issue, implementing infection control measures has become essential to reduce the morbidity and mortality associated with HAIs. Standard guidelines, incorporating various elements of evidence-based care, have been established to ensure a consistent approach among healthcare workers (HCWs) for effective infection control. Additionally, specific infection prevention, post-exposure prophylaxis for bloodborne pathogens, and immunizations for healthcare workers are other important infection control measures aimed at lowering HAI rates [15].

Numerous studies have demonstrated variations in infection control knowledge among healthcare workers (HCWs) based on their role and years of experience [16-17]. Additionally, research has identified differences in the actual understanding of infection transmission and control, as well as how HCWs interpret and apply this knowledge [18-19].

Likewise, various studies have highlighted the broad benefits of

effective infection control measures, which include improvements in morbidity and mortality rates, prevention of disease transmission, and the promotion of cost-effective healthcare.

Simple, practical procedures that are part of standard precautions against healthcare-associated infections (HCAIs) have proven effective in reducing their occurrence. Proper hand hygiene can significantly decrease the prevalence of HCAIs. Enhanced compliance with standard alcohol-based hand rubs has been shown to lower the rate of nosocomial infections by up to 40%. Additionally, improving healthcare workers' perceptions of hand hygiene through appropriate education and awareness initiatives has been demonstrated to boost compliance among medical staff.

Preventing HCAIs may require a multifaceted approach, which can also positively influence other areas of medical practice. For instance, a study conducted in Indonesia reported a 22% reduction in the inappropriate use of antibiotics following the implementation of a comprehensive infection control and antibiotic stewardship program.

This study aims to evaluate the knowledge and practices related to infection control among healthcare workers at a tertiary institution, with the goal of enhancing current standards.

MATERIALS AND METHODS:

This research was conducted at a Tertiary Referral Center in Maharashtra, which has a bed capacity of 800 and provides tertiary-level care across various medical and surgical subspecialties, supported by well-equipped laboratories. The data was conducted on 250 patients. The hospital serves as a referral center in India. An infection control committee at the hospital organizes mandatory workshops for all staff on a quarterly basis.

Study Design

The study employed a descriptive cross-sectional survey methodology, targeting 250 individual nurses engaged in direct patient care over a one-month period. Data were collected using a pretested, structured, self-administered questionnaire, distributed to participants by trained research assistants. These assistants explained the study's purpose to respondents and obtained their consent before the questionnaire was completed anonymously. Participants were asked to return the questionnaire within a limited time span or by the end of their workday if that was not possible.

Based on the pretest, some questions were revised or removed for clarity. The questions were developed after reviewing relevant published literature. The validity of the questionnaire was confirmed with a Cronbach's alpha internal consistency coefficient of 0.7958.

Demographic information collected included age, sex, role, years of experience (YOE), and the respondents' workstations. The questionnaire contained 20 primary questions focused on knowledge related to hand hygiene, standard precautions, needlestick injuries (NSIs), and post-exposure prophylaxis.

A correct answer received one point, while an incorrect answer received none. Practice was evaluated through four positive questions each on hand hygiene and standard precautions, using a five-point Likert scale (i.e., always, most of the time, sometimes, rarely, never). Scores of 5, 4, 3, 2, and 1 were assigned to the respective responses. The KAP (Knowledge, Attitude, Practice) scores for each participant were then used to calculate percentage KAP scores. A score of 0–69% was deemed poor, while a score of 70% or higher was considered good for both knowledge and practice.

Study Population And Sampling Method

The study population consisted of doctors and nurses and other paramedic staff on duty in the hospital's various wards at the time of the study, excluding those off duty and other medical and non-medical personnel. Participants were recruited using convenience sampling.

Statistical Analysis

Responses were recorded in Microsoft Excel and subsequently transferred to STATA version 10 for analysis. Means, medians, standard deviations, and proportions were calculated as appropriate. Differences between the two groups were analyzed using Chi-square ($\chi 2$) tests and Student's t-tests. The Mann–Whitney U-test was used to assess differences in median percentage knowledge and practice scores between doctors and nurses. Spearman's rho correlation was used to evaluate the relationship between percentage knowledge and practice scores, with a significance level set at $P \leq 0.05$.

Ethics

Ethical approval was granted by the Ethics Committee of the Hospital. Informed consent was obtained from respondents prior to administering the questionnaire, following an explanation of the study's purpose by the research assistants. The study adhered to the principles outlined in the Helsinki Declaration.

RESULTS:

The study sample consisted of individuals aged 20-60 years, with the majority (40.8%) aged 31-40 years. Females represented 43.2% of the population, while males made up 56.8%. Regarding years of service, 31.2% of respondents had more than 15 years of experience, while 27.2% had 10-15 years, 25.2% had 5-10 years, and 16.4% had less than 5 years of service.

Most respondents (58.4%) worked in wards, while 11.2% were in operating theaters (OT), 8.0% in outpatient departments (OPD), and 22.4% in other departments. A significant majority (94.0%) consistently discarded biomedical waste according to guidelines, though 4.8% reported only sometimes following the guidelines.

When asked about training for biomedical waste disposal, 51.6% indicated they received training regularly, while 38.8% sometimes received it, and a small percentage (0.8%) never received training. In terms of hand hygiene, 89.6% always washed their hands after patient contact, while 9.6% sometimes did. Additionally, 87.6% always wore gloves when handling blood samples, and 93.6% did so for saliva or sputum samples. Similarly, 92.0% consistently wore gloves when handling patient skin breaches.

Regarding the disposal of different types of medical waste, most respondents (88.8%) correctly disposed of surgical blades in white bins, and 64.8% discarded broken ampoules in blue bins. For blood bags, 35.6% used red bins, which aligns with guidelines. Additionally, 74.8% of participants practiced both medical and surgical handwashing.

In terms of infection knowledge, 96.0% correctly identified all types of infections (bacterial, viral, fungal, and protozoa), and 92.4% understood that hospital-acquired microorganisms could be transmitted through various routes, including air and droplets. To prevent catheter-associated urinary tract infections (CAUTI), 84.4% of respondents used gloves, while 69.2% indicated masks were appropriate for preventing communicable infections as depicted in table 1.

Table 1: Distribution Of Age, Gender, Departement And Biomedical Waste Discard.

		Count	Column N %
Age in years	20-30	86	34.4%
	31-40	102	40.8%
	41-50	48	19.2%
	51-60	14	5.6%
Gender	Female	108	43.2%
	Male	142	56.8%
Years of service	10-15 years	68	27.2%
	5-10 years	63	25.2%
	Less than 5 years	41	16.4%
	More than 15 years	78	31.2%
Experience	<5 years	41	16.4%

	5-10 years	63	25.2%
	10-15 years	68	27.2%
	>15 years	78	31.2%
Department	Wards	146	58.4%
	OT	28	11.2%
	OPD	20	8.0%
	Others	56	22.4%
[Do you Discard the biomedical waste as per the guidelines]	Always	235	94.0%
	Rarely	3	1.2%
	Sometimes	12	4.8%
[How often you receive training for disposal of BMW in your Hospital]	Always	129	51.6%
	Never	2	0.8%
	Rarely	22	8.8%
	Sometimes	97	38.8%
[Do you wash hands when came in contact with patient]	Always	224	89.6%
	Rarely	2	0.8%
	Sometimes	24	9.6%
[Do you wear gloves when handling Blood samples]	Always	219	87.6%
	Rarely	6	2.4%
	Sometimes	25	10.0%
[Do you wear gloves while handling Saliva or sputum samples]	Always	234	93.6%
	Rarely	2	0.8%
	Sometimes	14	5.6%
[Do you wear gloves while handling Syringes]	Always	192	76.8%
	Never	4	1.6%
	Rarely	11	4.4%
	Sometimes	43	17.2%
[Do you wear Gloves while handling patient breached skin]	Always	230	92.0%
	Never	1	0.4%
	Rarely	4	1.6%
	Sometimes	15	6.0%
[Do you wear gloves while assisting in the dressing]	Always	207	82.8%
	Never	5	2.0%
	Rarely	6	2.4%
	Sometimes	32	12.8%
[Do you wear mask when came in contact with respiratory infection]	Always	220	88.0%
	Rarely	3	1.2%
	Sometimes	27	10.8%
[Do you wash hands when came in contact with blood, body fluids, secretions and excreation]	Always	239	95.6%
	Rarely	5	2.0%
	Sometimes	6	2.4%
What do you mean by BMW ?	Biological Management of Waste	4	1.6%
	Biological Medical Waste	34	13.6%
	Biomedical Management of Waste	108	43.2%
	Biomedical Waste	104	41.6%
Blue: color of Bins available as per latest guidelines	No	41	16.4%
	Yes	209	83.6%
White: color of Bins available as per latest guidelines	No	131	52.4%
	Yes	119	47.6%
Red: color of Bins available as per latest guidelines	No	8	3.2%
	Yes	242	96.8%
Yellow: color of Bins available as per latest guidelines	No	8	3.2%
	Yes	242	96.8%
Black: color of Bins available as per latest guidelines	No	127	50.8%
	Yes	123	49.2%
Surgical blade is disposed in	Black	4	1.6%
	Blue	18	7.2%
	Red	6	2.4%
	White	222	88.8%
Broken Ampoules are discarded in	Black	8	3.2%
	Blue	162	64.8%
	Red	6	2.4%
	White	74	29.6%
Blood bag is discarded in	Blue	6	2.4%
	Red	89	35.6%
	Yellow	155	62.0%
Types of Hand Washing	Both	187	74.8%
	Medical	19	7.6%
	None	12	4.8%
	Surgical	32	12.8%

According to WHO, How many steps are there in medical hand wash	Eight	19	7.6%
	Nine	14	5.6%
	Seven	117	46.8%
	Six	100	40.0%
What are the various types of infection ?	All of the above	240	96.0%
	Bacterial	5	2.0%
	Fungal	4	1.6%
	Virus and Protozoa	1	0.4%
What are the various routes of transmission for microorganisms found in the hospital ?	Air	10	4.0%
	All of the above	231	92.4%
	Droplets	8	3.2%
	Skin	1	0.4%
Appropriate PPE is used to prevent CAUTI (Cather Associated Urinary Tract Infection) infection	Gloves	211	84.4%
	Goggles	1	0.4%
	Gown	31	12.4%
	Mask	7	2.8%
Appropriate PPE is used to prevent Communicable infection	Gloves	49	19.6%
	Goggles	3	1.2%
	Gown	25	10.0%
	Mask	173	69.2%

The chi-square analysis showed several significant associations between various demographic and behavioral factors and departments (wards, OT, OPD, and others) in the hospital.

Age Group:
There was a highly significant association between age and department. In the 20–30 age group, 40.4% worked in the wards, while 26.8% were in other departments. In the 31–40 age group, 43.8% were in the wards and 53.6% in the OT. The 41–50 age group had a significant presence in OPD (50%) and other departments (39.3%). The majority (71.4%) of those aged 51–60 worked in the wards.

Gender was also significantly associated with the department. Females were primarily working in the wards (67.1%), whereas males were predominantly in OT (78.6%) and OPD (95%). There was a significant association between years of service and department. Staff with more than 15 years of service were mainly found in other departments (51.8%) and OPD (55%), whereas those with 5–10 years of service were mostly in the wards (28.1%).

No significant association was found between departments and whether staff discarded biomedical waste according to guidelines. Although most respondents reported always following guidelines (96.6% in wards, 92.9% in OT, 90% in OPD, and 89.3% in other departments). However, there was a significant difference in the frequency of training for BMW disposal in other departments receiving regular training.

There was no significant difference across departments in handwashing when coming in contact with patients, although the majority reported always washing hands (91.8% in wards, 89.3% in OT and other departments, and 75% in OPD). A significant association was found for glove use when handling blood samples, with the highest adherence in other departments (94.6%).

PPE usage to prevent catheter-associated urinary tract infections (CAUTI) varied significantly across departments, with the majority using gloves in wards (91.1%) and OT (78.6%). There was no significant association between departments and the prevention of communicable infections using PPE, although gloves were predominantly used.

Significant associations were noted in the disposal of surgical blades with the majority being discarded in white bins. Additionally, broken ampoules were mostly discarded in blue bins with significant differences across departments. Blood bags showed a significant association, with most being disposed of in red bins.

In summary, significant relationships exist between departments and various factors, such as age, gender, years of service, PPE use, and waste disposal practices as shown in table 2.

Table 2 : Comparison within the Departments using Chi Square

	Categories	N	Department				Chi square	P value
			Wards (N (%))	OT (N (%))	OPD (N (%))	Others (N (%))		
Age in years	20-30	86	59 (40.4)	8 (28.6)	4 (20)	15 (26.8)	41.192	**<0.001**
	31-40	102	64 (43.8)	15 (53.6)	6 (30)	17 (30.4)		
	41-50	48	14 (9.6)	2 (7.1)	10 (50)	22 (39.3)		
	51-60	14	9 (6.2)	3 (10.7)	0 (0)	2 (3.6)		
Gender	Female	108	98 (67.1)	6 (21.4)	1 (5)	3 (5.4)	84.039	**<0.001**
	Male	142	48 (32.9)	22 (78.6)	19 (95)	53 (94.6)		
Years of service	10-15 years	68	44 (30.1)	11 (39.3)	3 (15)	10 (17.9)	27.123	**0.001**
	5-10 years	63	41 (28.1)	8 (28.6)	4 (20)	10 (17.9)		
	Less than 5 years	41	30 (20.5)	2 (7.1)	2 (10)	7 (12.5)		
	More than 15 years	78	31 (21.2)	7 (25)	11 (55)	29 (51.8)		
Experience	<5 years	41	30 (20.5)	2 (7.1)	2 (10)	7 (12.5)	27.123	**0.001**
	5-10 years	63	41 (28.1)	8 (28.6)	4 (20)	10 (17.9)		
	10-15 years	68	44 (30.1)	11 (39.3)	3 (15)	10 (17.9)		
	>15 years	78	31 (21.2)	7 (25)	11 (55)	29 (51.8)		
[Do you Discard the biomedical waste as per the guidelines]	Always	235	141 (96.6)	26 (92.9)	18 (90)	50 (89.3)	7.1	0.312
	Rarely	3	1 (0.7)	0 (0)	1 (5)	1 (1.8)		
	Sometimes	12	4 (2.7)	2 (7.1)	1 (5)	5 (8.9)		
[How often you receive training for disposal of BMW in your Hospital]	Always	129	70 (47.9)	13 (46.4)	11 (55)	35 (62.5)	17.787	**0.038**
	Never	2	2 (1.4)	0 (0)	0 (0)	0 (0)		
	Rarely	22	8 (5.5)	2 (7.1)	2 (10)	10 (17.9)		
	Sometimes	97	66 (45.2)	13 (46.4)	7 (35)	11 (19.6)		

[Do you wash hands when came in contact with patient]	Always	224	134 (91.8)	25 (89.3)	15 (75)	50 (89.3)	9.642	0.141
	Rarely	2	0 (0)	0 (0)	1 (5)	1 (1.8)		
	Sometimes	24	12 (8.2)	3 (10.7)	4 (20)	5 (8.9)		
[Do you wear gloves when handling Blood samples]	Always	219	122 (83.6)	26 (92.9)	18 (90)	53 (94.6)	15.62	**0.016**
	Rarely	6	2 (1.4)	1 (3.6)	2 (10)	1 (1.8)		
	Sometimes	25	22 (15.1)	1 (3.6)	0 (0)	2 (3.6)		
[Do you wear gloves while handling Saliva or sputum samples]	Always	234	136 (93.2)	27 (96.4)	18 (90)	53 (94.6)	10.769	0.096
	Rarely	2	0 (0)	1 (3.6)	1 (5)	0 (0)		
	Sometimes	14	10 (6.8)	0 (0)	1 (5)	3 (5.4)		
[Do you wear gloves while handling Syringes]	Always	192	104 (71.2)	23 (82.1)	15 (75)	50 (89.3)	16.042	0.066
	Never	4	3 (2.1)	1 (3.6)	0 (0)	0 (0)		
	Rarely	11	7 (4.8)	0 (0)	3 (15)	1 (1.8)		
	Sometimes	43	32 (21.9)	4 (14.3)	2 (10)	5 (8.9)		
[Do you wear Gloves while handling patient breached skin]	Always	230	135 (92.5)	26 (92.9)	18 (90)	51 (91.1)	7.076	0.629
	Never	1	1 (0.7)	0 (0)	0 (0)	0 (0)		
	Rarely	4	0 (0)	1 (3.6)	1 (5)	2 (3.6)		
	Sometimes	15	10 (6.8)	1 (3.6)	1 (5)	3 (5.4)		
[Do you wear gloves while assisting in the dressing]	Always	207	113 (77.4)	22 (78.6)	19 (95)	53 (94.6)	14.228	0.114
	Never	5	4 (2.7)	1 (3.6)	0 (0)	0 (0)		
	Rarely	6	3 (2.1)	1 (3.6)	1 (5)	1 (1.8)		
	Sometimes	32	26 (17.8)	4 (14.3)	0 (0)	2 (3.6)		
[Do you wear mask when came in contact with respiratory infection]	Always	220	128 (87.7)	24 (85.7)	18 (90)	50 (89.3)	6.79	0.341
	Rarely	3	0 (0)	1 (3.6)	1 (5)	1 (1.8)		
	Sometimes	27	18 (12.3)	3 (10.7)	1 (5)	5 (8.9)		
[Do you wash hands when came in contact with blood, body fluids, secretions and excreation]	Always	239	141 (96.6)	24 (85.7)	19 (95)	55 (98.2)	11.851	0.065
	Rarely	5	2 (1.4)	1 (3.6)	1 (5)	1 (1.8)		
	Sometimes	6	3 (2.1)	3 (10.7)	0 (0)	0 (0)		
What do you mean by BMW ?	Biological Management of Waste	4	1 (0.7)	1 (3.6)	1 (5)	1 (1.8)	5.869	0.753
	Biological Medical Waste	34	18 (12.3)	3 (10.7)	3 (15)	10 (17.9)		
	Biomedical Management of Waste	108	69 (47.3)	11 (39.3)	8 (40)	20 (35.7)		
	Biomedical Waste	104	58 (39.7)	13 (46.4)	8 (40)	25 (44.6)		
Blue: color of Bins available as per latest guidelines	No	41	27 (18.5)	3 (10.7)	1 (5)	10 (17.9)	3.109	0.375
	Yes	209	119 (81.5)	25 (89.3)	19 (95)	46 (82.1)		
White: color of Bins available as per latest guidelines	No	131	81 (55.5)	15 (53.6)	10 (50)	25 (44.6)	1.968	0.579
	Yes	119	65 (44.5)	13 (46.4)	10 (50)	31 (55.4)		
Red: color of Bins available as per latest guidelines	No	8	4 (2.7)	1 (3.6)	1 (5)	2 (3.6)	0.346	0.951
	Yes	242	142 (97.3)	27 (96.4)	19 (95)	54 (96.4)		
Yellow: color of Bins available as per latest guidelines	No	8	4 (2.7)	1 (3.6)	1 (5)	2 (3.6)	0.346	0.951
	Yes	242	142 (97.3)	27 (96.4)	19 (95)	54 (96.4)		
Black: color of Bins available as per latest guidelines	No	127	69 (47.3)	14 (50)	11 (55)	33 (58.9)	2.361	0.501
	Yes	123	77 (52.7)	14 (50)	9 (45)	23 (41.1)		
Surgical blade is disposed in	Black	4	1 (0.7)	1 (3.6)	0 (0)	2 (3.6)	21.434	**0.011**
	Blue	18	13 (8.9)	0 (0)	2 (10)	3 (5.4)		
	Red	6	0 (0)	0 (0)	1 (5)	5 (8.9)		
	White	222	132 (90.4)	27 (96.4)	17 (85)	46 (82.1)		
Broken Ampoules are discarded in	Black	8	4 (2.7)	1 (3.6)	0 (0)	3 (5.4)	17.85	**0.037**
	Blue	162	106 (72.6)	17 (60.7)	11 (55)	28 (50)		
	Red	6	0 (0)	1 (3.6)	1 (5)	4 (7.1)		
	White	74	36 (24.7)	9 (32.1)	8 (40)	21 (37.5)		
Blood bag is discarded in	Blue	6	0 (0)	0 (0)	1 (5)	5 (8.9)	31.442	**<0.001**
	Red	89	46 (31.5)	5 (17.9)	8 (40)	30 (53.6)		
	Yellow	155	100 (68.5)	23 (82.1)	11 (55)	21 (37.5)		
Types of Hand Washing	Both	187	110 (75.3)	21 (75)	16 (80)	40 (71.4)	8.244	0.51
	Medical	19	10 (6.8)	0 (0)	1 (5)	8 (14.3)		
	None	12	8 (5.5)	1 (3.6)	1 (5)	2 (3.6)		
	Surgical	32	18 (12.3)	6 (21.4)	2 (10)	6 (10.7)		

According to WHO, How many steps are there in medical hand wash	Eight	19	9 (6.2)	4 (14.3)	3 (15)	3 (5.4)	12.313	0.196
	Nine	14	11 (7.5)	1 (3.6)	1 (5)	1 (1.8)		
	Seven	117	71 (48.6)	16 (57.1)	6 (30)	24 (42.9)		
	Six	100	55 (37.7)	7 (25)	10 (50)	28 (50)		
What are the various types of infection ?	All of the above	240	142 (97.3)	25 (89.3)	18 (90)	55 (98.2)	9.919	0.357
	Bacterial	5	1 (0.7)	2 (7.1)	1 (5)	1 (1.8)		
	Fungal	4	2 (1.4)	1 (3.6)	1 (5)	0 (0)		
	Virus and Protozoa	1	1 (0.7)	0 (0)	0 (0)	0 (0)		
What are the various routes of transmission for microorganisms found in the hospital ?	Air	10	4 (2.7)	5 (17.9)	0 (0)	1 (1.8)	26.98	**0.001**
	All of the above	231	138 (94.5)	23 (82.1)	17 (85)	53 (94.6)		
	Droplets	8	3 (2.1)	0 (0)	3 (15)	2 (3.6)		
	Skin	1	1 (0.7)	0 (0)	0 (0)	0 (0)		
Appropriate PPE is used to prevent CAUTI (Cather Associated Urinary Tract Infection) infection	Gloves	211	133 (91.1)	22 (78.6)	15 (75)	41 (73.2)	30.502	**<0.001**
	Goggles	1	0 (0)	0 (0)	1 (5)	0 (0)		
	Gown	31	11 (7.5)	3 (10.7)	4 (20)	13 (23.2)		
	Mask	7	2 (1.4)	3 (10.7)	0 (0)	2 (3.6)		
Appropriate PPE is used to prevent Communicable infection	Gloves	49	29 (19.9)	7 (25)	5 (25)	8 (14.3)	16.88	0.051
	Goggles	3	1 (0.7)	0 (0)	0 (0)	2 (3.6)		
	Gown	25	9 (6.2)	1 (3.6)	4 (20)	11 (19.6)		
	Mask	173	107 (73.3)	20 (71.4)	11 (55)	35 (62.5)		

The results of the chi-square tests reveal significant gender differences across multiple categories. For age, the distribution was highly significant. The majority of females (48.1%) were aged 20-30 years, while the largest percentage of males (47.2%) were in the 31-40 year age group. In contrast, only 23.9% of males were in the 20-30 year group, and 32.4% of females were aged 31-40 years.

A significant difference was observed in departmental distribution. Most females (90.7%) were found in the wards, while males were more evenly distributed, with 37.3% in "Other" departments, 33.8% in the wards, and 15.5% in the OT.

Experience also showed a significant association with gender. Females were more likely to have less than 5 years of experience (31.5%), while males had greater representation in the 10-15 year (33.8%) and >15 year (38.7%) categories.

The frequency of training on Biomedical Management of waste (BMW) disposal was also significantly different between genders, with 65.5% of males always receiving training, compared to only 33.3% of females. A similar pattern was observed for the use of gloves when handling blood samples, where males (93.7%) were significantly more likely to always wear gloves than females (79.6%).

In terms of glove usage when handling syringes, a significant difference was seen with 83.8% of males always wearing gloves compared to 67.6% of females. Additionally, 89.4% of males always wore gloves while assisting in dressing, compared to 74.1% of females.

Further, gender differences were noted in knowledge regarding BMW guidelines. A higher proportion of males correctly identified “Biomedical Management of Waste" as the meaning of BMW. There was also a significant gender difference in knowledge about the blue color of bins with 88% of males correctly identifying this, compared to 77.8% of females.

Concerning the disposal of blood bags, there was a highly significant gender difference, with 78.7% of females correctly identifying yellow as the appropriate bin, while only 49.3% of males did so.

The type of handwashing practices also differed significantly by gender. A higher percentage of females (82.4%) practiced both medical and surgical handwashing, compared to 69% of males. Additionally, males were more likely to identify appropriate PPE to prevent CAUTI, with 74.6% selecting gloves compared to 97.2% of females.

Finally, regarding PPE usage for communicable infections, gloves were selected by 76.9% of females and 63.4% of males, with a significant difference between the groups as depicted in Table 3.

Table 3: Comparison Of Gender With Variables.

	Categories	N	Gender		Chi square	P value
			Female (N (%))	Male (N (%))		
Age in years	20-30	86	52 (48.1)	34 (23.9)	26.324	**<0.001**
	31-40	102	35 (32.4)	67 (47.2)		
	41-50	48	11 (10.2)	37 (26.1)		
	51-60	14	10 (9.3)	4 (2.8)		
Department	Wards	146	98 (90.7)	48 (33.8)	84.039	**<0.001**
	OT	28	6 (5.6)	22 (15.5)		
	OPD	20	1 (0.9)	19 (13.4)		
	Others	56	3 (2.8)	53 (37.3)		
Experience	<5 years	41	34 (31.5)	7 (4.9)	38.543	**<0.001**
	5-10 years	63	31 (28.7)	32 (22.5)		
	10-15 years	68	20 (18.5)	48 (33.8)		
	>15 years	78	23 (21.3)	55 (38.7)		
[Do you Discard the biomedical waste as per the guidelines]	Always	235	103 (95.4)	132 (93)	2.331	0.312
	Rarely	3	0 (0)	3 (2.1)		
	Sometimes	12	5 (4.6)	7 (4.9)		
[How often you receive training for disposal of BMW in your Hospital]	Always	129	36 (33.3)	93 (65.5)	27.619	**<0.001**
	Never	2	2 (1.9)	0 (0)		
	Rarely	22	11 (10.2)	11 (7.7)		
	Sometimes	97	59 (54.6)	38 (26.8)		
[Do you wash hands when came in contact with patient]	Always	224	97 (89.8)	127 (89.4)	1.59	0.452
	Rarely	2	0 (0)	2 (1.4)		
	Sometimes	24	11 (10.2)	13 (9.2)		

[Do you wear gloves when handling Blood samples]	Always	219	86 (79.6)	133 (93.7)	12.453	**0.002**
	Rarely	6	3 (2.8)	3 (2.1)		
	Sometimes	25	19 (17.6)	6 (4.2)		
[Do you wear gloves while handling Saliva or sputum samples]	Always	234	101 (93.5)	133 (93.7)	1.785	0.41
	Rarely	2	0 (0)	2 (1.4)		
	Sometimes	14	7 (6.5)	7 (4.9)		
[Do you wear gloves while handling Syringes]	Always	192	73 (67.6)	119 (83.8)	15.431	**0.001**
	Never	4	0 (0)	4 (2.8)		
	Rarely	11	7 (6.5)	4 (2.8)		
	Sometimes	43	28 (25.9)	15 (10.6)		
[Do you wear Gloves while handling patient breached skin]	Always	230	100 (92.6)	130 (91.5)	4.438	0.218
	Never	1	1 (0.9)	0 (0)		
	Rarely	4	0 (0)	4 (2.8)		
	Sometimes	15	7 (6.5)	8 (5.6)		
[Do you wear gloves while assisting in the dressing]	Always	207	80 (74.1)	127 (89.4)	10.95	**0.012**
	Never	5	3 (2.8)	2 (1.4)		
	Rarely	6	3 (2.8)	3 (2.1)		
	Sometimes	32	22 (20.4)	10 (7)		
[Do you wear mask when came in contact with respiratory	Always	220	96 (88.9)	124 (87.3)	0.203	0.904
	Rarely	3	1 (0.9)	2 (1.4)		
	Sometimes	27	11 (10.2)	16 (11.3)		
[Do you wash hands when came in contact with blood, body	Always	239	104 (96.3)	135 (95.1)	1.219	0.543
	Rarely	5	1 (0.9)	4 (2.8)		
	Sometimes	6	3 (2.8)	3 (2.1)		
What do you mean by BMW ?	Biological Management of Waste	4	1 (0.9)	3 (2.1)	16.426	**0.001**
	Biological Medical Waste	34	9 (8.3)	25 (17.6)		
	Biomedical Management of Waste	108	62 (57.4)	46 (32.4)		
	Biomedical Waste	104	36 (33.3)	68 (47.9)		
Blue: color of Bins available as per latest guidelines	No	41	24 (22.2)	17 (12)	4.701	**0.03**
	Yes	209	84 (77.8)	125 (88)		
White: color of Bins available as per latest guidelines	No	131	60 (55.6)	71 (50)	0.759	0.384
	Yes	119	48 (44.4)	71 (50)		
Red: color of Bins available as per latest guidelines	No	8	2 (1.9)	6 (4.2)	1.116	0.291
	Yes	242	106 (98.1)	136 (95.8)		
Yellow: color of Bins available as per latest guidelines	No	8	2 (1.9)	6 (4.2)	1.116	0.291
	Yes	242	106 (98.1)	136 (95.8)		
Black: color of Bins available as per latest guidelines	No	127	50 (46.3)	77 (54.2)	1.543	0.214
	Yes	123	58 (53.7)	65 (45.8)		
Surgical blade is disposed in	Black	4	0 (0)	4 (2.8)	5.184	0.159
	Blue	18	9 (8.3)	9 (6.3)		
	Red	6	1 (0.9)	5 (3.5)		
	White	222	98 (90.7)	124 (87.3)		
Broken Ampoules are discarded in	Black	8	1 (0.9)	7 (4.9)	15.395	**0.002**
	Blue	162	83 (76.9)	79 (55.6)		
	Red	6	0 (0)	6 (4.2)		
	White	74	24 (22.2)	50 (35.2)		
Blood bag is discarded in	Blue	6	1 (0.9)	5 (3.5)	22.666	**<0.001**
	Red	89	22 (20.4)	67 (47.2)		
	Yellow	155	85 (78.7)	70 (49.3)		
Types of Hand Washing	Both	187	89 (82.4)	98 (69)	8.995	**0.029**
	Medical	19	3 (2.8)	16 (11.3)		
	None	12	3 (2.8)	9 (6.3)		
	Surgical	32	13 (12)	19 (13.4)		
According to WHO, How many steps are there in medical hand wash	Eight	19	5 (4.6)	14 (9.9)	5.577	0.134
	Nine	14	9 (8.3)	5 (3.5)		
	Seven	117	54 (50)	63 (44.4)		
	Six	100	40 (37)	60 (42.3)		
What are the various types of infection ?	All of the above	240	106 (98.1)	134 (94.4)	4.73	0.193
	Bacterial	5	0 (0)	5 (3.5)		
	Fungal	4	2 (1.9)	2 (1.4)		
	Virus and Protozoa	1	0 (0)	1 (0.7)		
What are the various routes of transmission for microorganisms found in the hospital ?	Air	10	2 (1.9)	8 (5.6)	3.242	0.356
	All of the above	231	103 (95.4)	128 (90.1)		
	Droplets	8	3 (2.8)	5 (3.5)		
	Skin	1	0 (0)	1 (0.7)		

Appropriate PPE is used to prevent CAUTI (Cather Associated Urinary Tract Infection) infection	Gloves	211	105 (97.2)	106 (74.6)	23.986	**<0.001**
	Goggles	1	0 (0)	1 (0.7)		
	Gown	31	3 (2.8)	28 (19.7)		
	Mask	7	0 (0)	7 (4.9)		
Appropriate PPE is used to prevent Communicable infection	Gloves	49	21 (19.4)	28 (19.7)	11.431	**0.01**
	Goggles	3	0 (0)	3 (2.1)		
	Gown	25	4 (3.7)	21 (14.8)		
	Mask	173	83 (76.9)	90 (63.4)		

DISCUSSION:

Nosocomial transmission of infections among healthcare providers and their patients often occurs due to violations of hospital infection control protocols. To address this issue, it is essential to educate healthcare providers on infection control measures, which can only be accomplished by identifying the gaps in their knowledge and practices. Our study reveals notable gaps in knowledge related to hand hygiene, with approximately half of the Nursing staff acknowledging the use of sterile gloves as the most effective way to prevent healthcare-associated infections (HCAIs). Overall, knowledge regarding the risk of transmission of bloodborne pathogens (such as HIV, HBV, and HCV) and post-exposure prophylaxis was inadequate. Although hand hygiene practices were generally reported as good, fewer respondents indicated they washed their hands between patient interactions, with nurses demonstrating better adherence to this practice. Additionally, there was a weak negative correlation between knowledge and practice among the respondents.

The inadequate knowledge regarding the transmission risks of bloodborne pathogens (such as HIV, HBV, and HCV) indicates that many respondents may underestimate these risks, potentially putting healthcare workers (HCWs) at greater risk of infection following exposure. This lack of awareness may account for the poor compliance observed in the use of basic personal protective equipment, such as gowns, caps, masks, and goggles, as many respondents likely undervalued the dangers associated with invasive procedures. According to the World Health Organization, 40% of HBV infections among HCWs worldwide result from occupational exposure. Most of these exposures occur due to blood or body fluids, particularly from needlestick injuries, which carry significant risks. Therefore, it is crucial to provide further education to HCWs about the risks of acquiring infections from exposure to blood and other bodily fluids.

In this study, over 40% of healthcare workers (HCWs) correctly answered more than 80% of the questions related to key aspects of infection control. While knowledge of hand hygiene was satisfactory, there was a notable lack of understanding of other infection control practices, with around 70% of nurses giving average or below-average responses. This is significant as it challenges the effectiveness of comprehensive in-house infection control programs and training. Other studies have reported differing levels of awareness about infection control among HCWs, with the percentage of those knowledgeable about these practices ranging from 16% to 75%.

Infection control encompasses hand hygiene, standard and transmission-based precautions, as well as care bundles for urinary tract infections, central line infections, and ventilator-associated pneumonia. The Centers for Disease Control and Prevention (CDC) and the Association for Professionals in Infection Control and Epidemiology (APIC) have recommended specific hand hygiene practices [20]. Earlier guidelines advocated the use of plain soap and waterless agents; however, numerous studies have shown that alcohol-based products are more effective at reducing bacterial counts[21]. Despite these established guidelines, compliance with hand hygiene practices among healthcare workers remains low.

Strict compliance with universal precautions is crucial for preventing infectious diseases [22]. The World Health Organization (WHO) estimates that around 3 million healthcare workers (HCWs) are at risk of occupational exposure to blood-borne viruses each year [23]. Research has consistently highlighted suboptimal and inconsistent adherence to standard and transmission-based precautions among HCWs in both developed and developing nations [24]. For example, Knight reported that only 58% of nurses in Australia used gloves while handling blood or blood collection equipment, while a study in North India found that 40% of HCWs recapped needles and only 32% wore eye protection when necessary [25-26]. In our study, roughly 70% of nursing professionals exhibited average or below-average knowledge of standard and transmission-based precautions. Additionally, a survey conducted by Sneddon revealed that only 57% of HCWs practiced universal precautions [27].

Recent studies have indicated that care bundles are advantageous when included in a comprehensive infection control program for both adults and pediatric populations [28].

In our hospital, there is a strong emphasis on training, leading us to have high expectations for our nursing professionals. Consequently, our scoring system and the interpretation of scores as excellent, good, average, or below average were stringent. The threshold for below-average performance was set at less than 70%, meaning that nurses with more than 12 incorrect responses were deemed to have inadequate knowledge.

In our study, more experienced nurses performed better than their less experienced counterparts. Specifically, 60% of nurses with over 8 years of experience and up to 70% of those with 5 to 8 years of experience demonstrated good knowledge of infection control practices, while only 30% of nurses with less than 5 years of experience scored above 80% (considered a good response). Notably, none of the nursing supervisors or charge nurses fell into the below-average category. This aligns with Suchitra's study, which found that greater experience in a hospital was significantly linked to increased knowledge, improved attitudes, and better implementation of infection control practices among various staff levels [29]. However, none of our more experienced nurses (those with over 8 years or 5 to 8 years) achieved excellent scores, potentially due to their higher involvement in administrative tasks rather than direct patient care. Only five nurses were classified as having excellent knowledge, and all of them were junior nurses. From our experience, these junior nurses often become valuable assets to the organization, as they tend to learn quickly and should be encouraged to take on training roles.

Numerous guidelines exist to promote effective infection control across various settings, and many professional journals offer recommendations. However, there is a pressing need for increased continuing education in this field. Insufficient education and training can lead to decreased compliance with essential infection control practices [30]. Additionally, other studies have indicated that training for healthcare workers (HCWs) on infection control policies is often lacking. Consequently, hospitals should reassess their policies regarding the provision of education and training related to infection prevention and control procedures.

CONCLUSION:

This study evaluated the knowledge and perceptions of nursing professionals regarding infection control practices at a tertiary care hospital. It aligns with existing literature indicating that while nurses possess a reasonably good understanding of infection control, significant improvements are necessary. To address these gaps, regular educational programs on infection control, standard and transmission-based precautions, as well as ward-based teaching on various care bundles, should be incorporated into in-house training. Such training should encompass educational and induction programs aimed at addressing deficiencies in the knowledge, attitudes, and practices of healthcare workers (HCWs) related to infection control. Fostering an institutional culture that prioritizes infection control practices will help reduce the incidence of healthcare-associated infections (HAIs).

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