Original Article

Compliance to Occupational Safety Measures among the Paramedical Workers in a Tertiary Hospital in Karnataka, South India

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Abstract

Background: The guidelines for minimizing occupational health risk from exposure to highly infectious diseases is already established but little information exists on the compliance of these measures among paramedical workers in India.

Objective: To study the awareness of occupational safety measures such as universal precautions, biomedical waste handling, disposal and its compliance in their daily practice.

Methods: A hospital-based cross-sectional study was undertaken in a tertiary private hospital in Karnataka, Bangalore, India. Data was collected using a pretested and predesigned proforma from 120 respondents: 85 nurses and 35 laboratory technicians.

Results: 27 (32%) nurses and 20 (57%) laboratory technicians could relate universal precautions to infection prevention. Only 6 (7%) nurses and 2 (6%) technicians had knowledge about proper hospital waste segregation. 45 (52.9%) nurses and 15 (42.8%) technicians had knowledge about post-exposure prophylaxis. 3 (4%) nurses and 9 (26%) technicians were formally trained in following universal precautions. Adequate hand washing was practiced among 17 (20%) nurses and none of the technicians. Faulty practice such as recapping of needle was prevalent among 57 (67%) nurses and 29 (83%) technicians. 32 (38%) nurses and 10 (29%) technicians received hepatitis B vaccine.

Conclusion: As knowledge and practice regarding different aspects of universal precautions was not satisfactory, training was warranted urgently in the study population. Also, suggestions were made to develop and implement institutional policies on the universal precautions and ensuring supply of personal protection equipment.

Keywords: Universal precautions; Needle-stick injury; Occupational health; Medical waste; India

Introduction

There are an estimated 60 million health care workers (HCWs) throughout the world and as per the World Health Organization (WHO) report work-related exposures had resulted in 2.5% HIV and 45% of hepatitis B and C cases among health service providers.[1] Another study revealed that in the year 2002, accidental sharps injuries resulted in 16 000 hepatitis C cases, 66 000 hepatitis B cases, and 1000 HIV cases among HCWs worldwide,[2] whereas for the year

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2000 unsafe injection practices resulted in 21 million (32%) of hepatitis B virus (HBV) infections; two million (40%) of hepatitis C virus (HCV) infections and 260 000 (5%) of new HIV infections.[3] As per annual report 2011–12 of National AIDS Control Organization (NACO), India has the third largest number of people living with HIV/AIDS and Karnataka being one of the high prevalent states with high risk status of Gulbarga District.[4] Awareness and practice of occupational safety measures and standard safety protocols is important for minimizing health risk at work place among HCWs and needs to be dealt urgently.

The paramedical workers form an important part in the health care team in a tertiary hospital. The standard guidelines are already launched by ILO, WHO and the Joint United Nations Programme on HIV/AIDS (UNAIDS) in 2010 to address the gap in the health care industry which makes the HCWs such as doctors, nurses and midwives, technical staff such as pharmacists and laboratory technicians, as well as health managers, cleaners, security guards and other support workers working in areas of high prevalence of HIV and TB at risk of occupational hazards due to lack of adequate access to protection and treatment,[5] but there is dearth of information regarding compliance with these measures among paramedical workers in India. The study is also important to help in minimizing stigma at health facilities related to handling of HIV-infected patients which arise due to incomplete knowledge about HIV transmission. Studies revealed that the HCWs' fear and misconceptions about HIV transmission must also be addressed by improving knowledge about safety measures and effective and accessible preventive measures at work place.[5,6] A study conducted in 1998 in India revealed better practice of universal precautions among doctors as compared to nurses and laboratory technician and identified them as high risk groups.[7] Therefore, this study was undertaken to study the awareness of standard occupational safety measures such as universal precautions including hospital waste handling and disposal and compliance in daily practice among paramedical workers.

Materials and Methods

A hospital-based cross-sectional study was undertaken from March 2011 to June 2011 in a tertiary private teaching hospital in Gulbarga District of Karnataka state, South India. The hospital was a 450-bed health care center. The existing policy of the hospital was to do HIV testing of all cases put up for surgical treatment; all positive cases were referred to a nearby government hospital or mission hospital located in outskirts of city assisted by an NGO, which had facilities for treating seriously-ill HIV-positive patients. The hospital also had its own integrated counseling and testing center (ICTC) for providing HIV testing services and counseling.

The study participants included all nurses and laboratory technicians working in the institution. Confidentiality of the participants' identity and response was ensured. Informed consent was taken prior to interview from the paramedical workers. An average of 25 minutes was required to collect data per respondent. Data was collected through interview with 120 participants—85 nurses and 35 laboratory technicians.

The assessment tool was a pretested and pre-designed questionnaire. The questions were related to the participants knowledge regarding blood-borne diseases, modes of transmission of HIV, and methods to prevent blood-borne diseases, knowledge about universal precaution including post-exposure prophylaxis (PEP) for HIV and practices of hand washing, disposal of needles and management of spillages of

TAKE-HOME MESSAGE

- Knowledge about and practice of universal precautions were not satisfactory among paramedical workers.
- Knowledge about color coding in hospital waste segregation was better in nurses than laboratory technicians.
- The knowledge about proper timing for initiation of post-exposure prophylaxis and reporting of injury was not adequate among both nurses and laboratory technicians.
- In spite of the current recommendations, recapping of needle is still in practice.
- Cleaning of spillage with sodium-hypochlorite to prevent contamination with HIV and HBV, as recommended in standard guidelines, is known to only 21.7% of the studied paramedical workers.
- Pre-placement vaccination against HBV was not performed for all the paramedical workers as recommended in guidelines—only 35% were immunized.

blood and body fluids, use of personal protective equipment at work, and HBV vaccination. Using a checklist, the participants were also observed to see if they actually followed the universal precautions. The checklist was prepared after some modifications considering the study setting, as per approved code of practice of Control of Substances Hazardous to Health Regulations 2002,[8] for assessing practices in disposal of hospital wastes such as syringes, sharps, needles, management of spillage of blood and body fluids, practicing standard precautions, HBV immunization and PEP at work in either a laboratory or a health care setting. Knowledge was evaluated by ascertaining whether participants had correct knowledge regarding each item on the proforma. The collected data were analyzed by Epi Info ver 7 (CDC, Atlanta, USA). The χ^2 or Fisher's exact test was used to compare proportions. A p value <0.05 was considered statistically significant.

Results

Table 1 shows demographic characteristics of the study population. The majority of the nurses belonged to young age group (18–32 years) with <3 years of work experience compared to the laboratory technicians in age who mostly aged more than 32 years with ≥5 years of work experience. The majority (65%) of respondents were males.

Table 2 shows that knowledge and awareness among the HCWs regarding various aspects of blood-borne diseases and universal precautions. The knowledge regarding HIV as an incurable infection, was present in 70 (83%) of the nurses and 32 (91%) technicians. The majority of the HCWs (71%) mentioned HBV as a blood-borne disease. Knowledge about HCV as a blood-borne disease, was significantly (p=0.007) more in laboratory technicians (18%) than nurses (10%).

It was found that 27 (32%) nurses and 20 (57%) laboratory technicians were not familiar with the term "universal/standard precautions" and could not relate it to occupational safety measures in prevention of HIV and other blood-borne diseases. But on further direct questioning, they could relate it to the use of gloves, masks, *etc*, with prevention of transmission of infection (Table 2). Sixty-five (77%) nurses and 20 (57%) laboratory technicians believed that used needles and syringes can be reused after proper disinfection. Regarding cleaning of blood spillages, only 18 (21%) nurses and 13 (37%) laboratory technicians said they would use sodium hypochlorite. Others mentioned alcohols/spirits, phenyl and fumigation as useful measures for disinfection. Only 6 (7%) nurses and 2 (6%) laboratory technicians had heard about the color coding in hospital waste segregation. Knowledge about

Table 1: Demographic characteristics of the study population (n=120)

Variables		Nurses (n=85), n (%)	Laboratory Technicians (n=35), n (%)	Total (n=120), n (%)
Age (yrs)	18–22	13 (15)	—	13 (10.8)
	23–27	47 (55)	1 (3)	48 (40)
	28–32	12 (14)	6 (17)	18 (15)
	33–37	8 (9)	16 (46)	24 (20)
	38–42	3 (4)	9 (26)	12 (10)
	>42	2 (2)	3 (9)	5 (4.2)
Gender	Male	46 (54)	32 (91)	78 (65)
	Female	39 (46)	3 (9)	42 (35)
Work experience (yrs)	<1	22 (26)	1 (3)	23 (19.2)
	1–2.9	40 (47)	3 (9)	43 (35.8)
	3–4.9	10 (12)	2 (6)	12 (10)
	≥5	13 (15)	29 (83)	42 (35)
Pre-professional education level	SSLC passed	7 (8)	10 (29)	17 (14.2)
	PU passed	60 (71)	15 (43)	75 (62.5)
	Graduate	18 (21)	10 (29)	28 (23.3)
Professional training (yrs)	1.5 yrs (GNM)	7 (8)	—	7 (5.8)
	2 yrs (DMLT, ANM)	—	10 (29)	10 (8.3)
	3 yrs (DMLT)	—	25 (71)	25 (20.8)
	3.5 yrs (GNM)	60 (71)	—	60 (50)
	4.5 yrs (BSc Nursing)	18 (21)	—	18 (15)

DMLT: Diploma in Medical Laboratory Technician course; GNM: General Nurse Midwife; ANM: Auxiliary Nurse Midwife

Table 2: Correct knowledge regarding universal precautions among the study population

Variables	Nurses (n=85), n (%)	Laboratory Technicians (n=35), n (%)	Total, n (%)	p value
HIV infection is incurable	70 (82)	32 (91)	102 (85)	NS
Needle-rick injury can transmit HIV	72 (85)	31 (89)	103 (85.8)	NS
Direct contact of open wound to infected blood can spread HIV	75 (88)	31 (89)	106 (88.3)	NS
Infected blood transfusions can spread...				
HIV	52 (61)	22 (63)	74 (61.7)	NS
HBV	63 (74)	22 (63)	85 (70.8)	NS
HCV	8 (9)	10 (29)	18 (15)	0.007*
Needles and syringes can be reused after disinfection	65 (77)	20 (57)	85 (70.8)	0.025*
Use Na-hypochlorite for cleaning infected blood spills	18 (21)	8 (23)	26 (21.7)	NS
Awareness about standard precaution measures				
Adequate hand washing	77 (91)	29 (83)	106 (88.3)	NS
Wearing gloves	80 (94)	25 (71)	105 (87.5)	<0.01†
Wearing masks	35 (42)	12 (34)	47 (39.2)	NS
Wearing eye protection	20 (24)	6 (17)	26 (21.7)	NS
Wearing plastic gown	2 (2)	3 (9)	5 (4.2)	NS
Relation of standard precautions with infection prevention	27 (32)	20 (57)	47 (39.2)	0.009*
Knowledge of color coding in hospital waste segregation	6 (7)	2 (6)	8 (6.7)	NS
PEP to be taken following accidental exposure	45 (53)	15 (43)	60 (50)	NS
Awareness about the ICTC in their hospital	23 (27)	20 (57)	43 (35.8)	<0.001*
Received formal NACO training	3 (4)	9 (26)	12 (10)	<0.001†

NS: not significant, *χ^2 test, †Fischer's exact test

PEP for HIV was present in only 45 (53%) nurses and 15 (43%) laboratory technicians. However, only 15 (18%) nurses and 6 (17%) technicians understood that PEP needs to be initiated immediately to be effective; none could tell the exact time within which PEP is 100% effective. Formal training in standard precautions was only received by only 3 (4%) nurses and 9 (26%) technicians under National AIDS Control Organization. The majority of the nurses (n=80, 94%) and laboratory tech-

Table 3: Occupational safety measures practiced among the study population

Practices	Nurses (n=85), n (%)	Laboratory Technicians (n=35), n (%)	Total (n=120), n (%)	p value
Recapping of needles	57 (67)	29 (83)	86 (71.7)	NS
Use of hub cutter before disposing needles	77 (91)	29 (83)	106 (88.3)	NS
Dispose needles and sharps in separate container	75 (88)	28 (80)	103 (85.8)	NS
Manual manipulation of needle	5 (6)	3 (9)	8 (6.7)	NS
Hand washing before and after every procedure				
Always*	17 (20)	—	17 (14.2)	
Sometimes	3 (4)	1 (3)	4 (3.3)	0.004†
Only specific cases	5 (6)	1 (3)	6 (5)	
Hepatitis B immunization	32 (38)	10 (29)	42 (35)	NS
Wearing protective footwear at work	17 (20)	—	17 (14.2)	NS
Care of exposed wounds on self at work				
Wear bandage and gloves	28 (33)	14 (40)	42 (35)	NS
Only non-waterproof bandage	45 (53)	16 (46)	61 (50.8)	NS
Keep away from duty	4 (5)	1 (3)	5 (4.1)	NS
No response	5 (9)	3 (86)	8 (6.7)	NS

*Statistically significant
†Fischer's exact test

nicians (n=27, 77%) stated that they need training in universal precautions.

Table 3 shows the practices related to personal protection and occupational safety measures. Faulty practices such as recapping of needles was present in 57 (67%) of nurses and 29 (83%) of laboratory technicians. Only 32 (38%) nurses and 10 (29%) laboratory technicians received HBV vaccine. Regarding special precautions taken in the presence of bodily wounds or compromised skin on hands and exposed parts of the body, it was found that 28 (33%) of the nurses would cover the site properly with bandage and wear gloves before handling the patient. Only 17 (20%) nurses and no technician wore protective footwear to work. Knowledge about and practice of personal protection measures such as wearing masks and gloves and aprons was higher among those paramedical workers working in labor rooms and operation theaters than those working in outpatients departments, wards and laboratories.

Table 4 shows few of the factors which found to influence the practice of standard precautions among the paramedical workers. Seventy-five (88%) nurses and 30 (86%) laboratory technicians said they would routinely practice these personal protective measures, if the hospital pro-

Table 4: Factors influencing practice of universal precautions in the study population

Factors mentioned by HCWs	Nurses (n=85), n (%)	Laboratory Technicians (n=35), n (%)	Total (n=120), n (%)
If consultant specifically warned or alerted	35 (41)	10 (29)	45 (37.5)
Known status of patient as HIV+/HBV+	40 (47)	16 (46)	56 (46.7)
If protective devices are readily available in hospital	75 (88)	30 (86)	105 (87.5)
Inconvenient and interferes with certain procedures	35 (44)	20 (57)	55 (45.8)
Too much times wasted on wearing and taking off protective devices	67 (78)	28 (80)	95 (79.2)
No proper knowledge about Universal Precautions	8 (9)	2 (6)	10 (8.3)

vides them with enough safety equipment such as masks and gloves at work place. Also a complete lack of knowledge about the standard precaution measures made few of the nurses (n=8, 9%) and laboratory technicians (n=2, 6%) vulnerable to risks.

Discussion

We found that the knowledge about occupational safety measures and universal precaution was inadequate among the studied paramedical HCWs (Table 2). Although they were not familiar with the term "universal precaution," they were practicing some of the methods. Doctors and higher specialties in medical professional were found to have better awareness and knowledge about the occupation safety and its practices compared to lower ranked HCWs.[9,10]

The knowledge about universal precaution was significantly (p=0.009) higher in laboratory technicians than nurses. This might be due to the higher years of work experience among technicians. Also, a significantly (p=0.02) higher percentage of nurses (77%) thought that needles and syringes can be reused compared to technicians (57%). Awareness regarding availability of ICTC at the hospital was significantly (p<0.001) higher in technicians (57%) than in nurses (27%).

Different HCWs underwent varying period of professional training (Table 1). Nurses pursued professional training either after passing class 10 or 12 compared to few who pursued professional training after earning their bachelor degree. It must be made mandatory for all midlevel and lower cadre of HCWs working in hospitals to get pre-placement training in reducing risks of infection transmission and regarding hospital waste management for a safer working environment. Similar views were brought forth in other studies.[10] Knowledge about different personal protective measures and their use was also not as per guidelines (Tables 2 and 3). A significantly (p=0.002) higher percentage of nurses (94%) mentioned "wearing gloves" as a personal protection measure than technicians (71%). Procedures on the use of personal protective equipment by HCWs and laboratory technicians are mentioned in the laboratory safety manual of the WHO

(2004). Wearing of back-opening gowns to cover street clothing, plastics water-proof aprons to prevent contamination of personal clothing, closed-toe footwear, face shields, goggles and spectacles with side shield to protect from splashes and injury from impacts, masks and respirators to prevent inhalation of aerosols, and disposable gloves to prevent contact with harmful microorganisms and hand protection is suggested in the manual.[11]

Practice of all components of universal precautions among the studied HCWs was not satisfactory compared to their existing knowledge (Table 3), in contrast to other studies where universal precautions were practiced by 73.6% of the HCWs. Compliance with personal protective measures such as wearing gloves and in terms of safe needles and sharps disposal surpassed the knowledge among nurses. Similarly, knowledge was higher than the actual practice of universal precautions for tasks such as handwashing among HCWs, which was also reported in other studies.[10-12]

In this study, faulty practices of recapping and manual manipulation were found in a high percentage of paramedical workers (72%). Recapping, disassembly and inappropriate disposal of needles increase the risk of needle-stick injury. Furthermore, these risks are accentuated by high injection rate in work setting like tertiary health care centers, most of which are provided with previously used syringes as found in few other studies.[3,13] In this study too, the paramedical workers believed that reuse of syringes and needles can practiced after adequate disinfection.

Although the studied participants disposed needles and sharps separately (Table 3), they did not understand well the color codes for segregation (red/blue/yellow/black) and disposal of biomedical waste. Only 31 (25.8%) of the studied HCWs knew the correct practice of cleaning of spillages of blood and body fluids with sodium-hypochlorite. One study found that despite poor knowledge among nurses, they had better compliance with proper handling and disposal of needles and sharps than doctors.[11] That study also revealed a deficiency in the teaching-learning process among doctors and paramedical workers. There seems to be misconception regarding effective methods of disinfection of spillages among few HCWs and only few mentioned used of phenyl, spirit, *etc*, instead of sodium-hypochlorite. Training in proper management of spillage is thus necessary for paramedical workers.

The studied HCWs also said that they would practice these barrier methods if they were made readily available at work stations (Table 4). The HCWs believed that they should receive a formal training in safety measures and their use to update and enhance their knowledge. Proper handwashing was practiced by only 17 (20%) of nurses and none of the laboratory technicians. Hand hygiene, use of personal protective equipment are the major components of universal precautions and are effective in preventing transmission of pathogens associated with health care.[14] Among the standard precautions advocated, hand hygiene is considered the most important one.[15]

Among susceptible HCWs who do not receive PEP, the risk of infection after needle-stick injury is 23%–62% for HBV and 0%–7% for HCV.[2] Half of the paramedical workers did not know what to do in case of an accidental exposure to infected blood. There is also no knowledge among the studied HCWs about whom to report in the hospital or from where to receive PEP in case of an accidental exposure. Only 23 (27%) nurses and 20 (57%) laboratory technicians knew about the ICTC present in their hospital. This is again an unacceptable status as post-exposure antiretroviral prophylaxis can reduce 80% risk of HIV transmission.[16] A study conducted in Delhi

reported that only 10.1% of self-reporting of needle-prick injury by the nurses were primarily from the department of OB/Gyn.[17]

The benefit of preventive measures such as hepatitis vaccine was perceived by only 42 (35%) of the studied HCWs post-employment, which should be increased by immediate implementation of a vaccination program. The value is much less compared to other studies where 81.9% nurses were immunized with HBV vaccine.[9] As per recommendation of WHO, all workers must receive pre-training immunization with HBV vaccine.[3,18] Other vaccines such as influenza, MMR, varicella, tetanus, diphtheria and pertussis, and meningococcal vaccine, are recommended for HCWs depending on the existing risks.[19,20]

The studied HCWs were asked about their level of education before entering the professional training (Table 1); it was done to understand their level of exposure to health-related issues and plan a teaching and training program for them. The majority of the paramedical workers felt the need of training in universal precautions. Many studies revealed that nurses and laboratory technicians had a relatively poor knowledge.[21,22] Similar views were found in another study conducted in Brazil.[23]

Table 4 shows various factors influencing the use of personal protective measures. It was found that the majority of the studied HCWs depend on doctors direction for observing personal protection for handling patients. Some mentioned time as a factor for avoiding personal protective measures. Similar results were found in other studies.[24,25]

The WHO guidelines mention three levels of control is prevention of hospital-acquired infections: The first is administrative controls, which are measures taken to ensure that the entire system is working effectively. The second is environmental and engineering controls, including cleaning of the environment, spatial separation and the ventilation of spaces. The third is to further decrease the risk of transmission and includes personal protection, which is the provision of the proper personal protective equipment (PPE) (*eg*, masks, respirators).[26]

A study attributed better hand hygiene maintenance among nurses to readiness and easiness of alcoholic-base gel and hand rubs instead of handwashing with soap, which is a little bit time-consuming.[26,27] Sustainability of the adherence to hand hygiene also depends on the integration of other components related to modification of behavior.[28] Other studies indicated that low compliance or the lack thereof, is directly related to the academicians and other health care professionals not setting an example, thereby acting as negative role models as often the behavior exhibited by these models is observed, imitated and repeated by students and young professionals.[29-31] Therefore, it was suggested to reinforce the importance of an educational foundation during their initial years of undergraduate and professional training which must be followed throughout the students' academic life, to ensure that a professional does not enter the hospital unprepared with respect to standard precaution measures. This academic preparation process must continue through permanent education programs.

Some studies have shown that the origin of the low compliance, especially with hand hygiene, lies in the academic training,[29-31] while others pointed to individual, group and institutional factors.[28]

The current study shows the urgent need for the institution to develop and implement specific policies on the practice of standard precautions, training of health care providers and ensuring supply of protective materials for improved safety. As many could not relate to the term universal precaution and diseases it prevents, prepa-

ration of training and teaching module for paramedical workers in simple and tailor-made to an understandable format needs to be developed. Increases awareness, particularly for PEP and management of spillages required to have a safe work environment and infection control.

Conflicts of Interest: None declared.

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