

Assessment of Knowledge, Attitudes and Practices Regarding Intravenous Injection Administration Among Nursing Faculty and Students: A Cross-Sectional Study at A Tertiary Care Centre

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ABSTRACT

Background: Knowledge, attitude, and consistent practice of injection safety are essential for safe intravenous medication administration. The present study evaluated the knowledge, attitude, and practice of nursing faculty and students regarding IV injection administration.

Methods: A cross-sectional survey was carried out at Sri Madhusudan Sai Institute of Medical Sciences and Research using a structured 22-item questionnaire. Knowledge, practice, and attitude were evaluated separately, and exploratory associations were examined using non-parametric tests.

Results: The median knowledge score was 9/13 (69.2%) and the median practice score was 20/21, while the median attitude score was 6/6 among 178 participants. Hand hygiene, allergy history, and glass-vial disposal had the highest levels of knowledge, while vein identification, syringe identification, glove indications, and the post-exposure prophylaxis time window had lower levels of knowledge. Immediate sharps disposal was reported by 98.3%, and 75.3% consistently avoided recapping needles. There was a positive correlation between knowledge and practice ($\rho=0.370$, $p<0.001$).

Conclusion: The general attitude and practices towards injection safety were favourable, but there were still some gaps in knowledge and practices that warrant targeted training and periodic audit.

KEY WORDS: Cirrhosis; Oesophageal varices; Portal hypertension; Platelet count; Serum albumin; Total bilirubin; Portal vein diameter; Splenomegaly; Platelet-to-spleen diameter ratio; Variceal bleeding.

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INTRODUCTION

The administration of intravenous medication is a vital component of hospital care, but is also a complex process with potentially immediate consequences if errors are made, due to the direct administration of medication into the circulation. The incidence of IV medication administration errors has been reported to be from about 5% to 63% in different settings, according to a recently published systematic review of 23 studies. The errors were related to the medication process, including dose, time, how the medication was given, rate of infusion, selection of diluent, and other factors [1].

There are more risks to consider when giving intravenous therapy than just choosing the right medication and dosage. Safe drug delivery involves preparation,

identification, technique of delivery, aseptic precautions and monitoring. McDowell et al. demonstrated that there are multiple points in the process of preparing and giving IV medications that could lead to errors [2]. Later, Kuitunen et al. conducted a systematic review and found that the administration, prescribing and preparation phases were the most vulnerable and that poor medication knowledge, medication calculation issues, lack of double checking and issues with high alert medicines were common causes of intravenous medication errors [3].

The nurses play a vital role in this process and are usually the last health care workers to view a medication before it is given to the patient. Safe administration is not just a

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technical skill, it is also the consistent application of medication administration principles and infection control precautions. It has been demonstrated that errors can occur for more than just a lack of knowledge. In a qualitative systematic review of medication errors, nurses reported that knowledge-related, personal, and work-related factors were associated with medication errors, such as lack of medication knowledge, fatigue, workload, and interruptions [4]. That is why it is important to assess knowledge and actual reported practices when assessing injection safety.

Safety of injection also has an occupational and infection-control component. These are all important steps to take to keep patients and healthcare workers safe: hand hygiene, wearing gloves the right way, never reusing syringes or recapping needles, safely disposing of sharps, and taking the appropriate steps when exposed. Even among health workers, studies in India have shown that there is lack of uniformity in knowledge of these areas. In a tertiary care teaching hospital in Delhi, Acharya et al. found that there was a lack of knowledge about principles of safe injection, post-exposure management and biomedical-waste disposal and that their educational intervention improved several aspects of knowledge [5].

The same issues have been reported particularly with nursing staff. Kulkarni et al. reported a high level of awareness of blood-borne infections and sharps disposal among the nurses in Maharashtra, but there were some important gaps in practice, including hand hygiene, needle recapping and prompt action following a needlestick injury [6]. The results indicate that a general knowledge of the principles is not sufficient to ensure the application of recommended practices in injection safety.

One of the most significant examples of the effects of unsafe handling is needle-stick injury. In a tertiary-care hospital study from Delhi, Sharma et al. found that 79.5% of the healthcare workers who participated in the study had suffered at least one needle-stick injury during their careers, with 34% of the injuries reported as being caused by recapping. A few of them had received post-exposure prophylaxis following their last injury [7]. The findings of this study highlight the need to assess knowledge of exposure management in addition to other everyday practices, such as recapping and immediate disposal of sharps.

Injection-safety behaviour can also differ between the nursing education and clinical practice settings. One cross-sectional study on nurses and nursing students found that 37.2% of the nurses and 55.6% of the nursing students had good knowledge and good practices regarding needle stick injury prevention, respectively. There was no significant difference between the KAP of nurses and students, indicating that there might be gaps in different levels of training and experience [8].

While the administration of IV medications is a common procedure, it is important to have information on knowledge, attitudes, and practices at the institutional level, as there may be variations in clinical experience, training, availability of safety devices, and adherence to infection-control procedures. In addition, item-level assessment can also provide clues to specific weaknesses that may not be seen in a total score. The present study, therefore, aimed to assess the knowledge, attitude, and practices of the nursing faculty and students of Sri Madhusudan Sai Institute of Medical Sciences and Research about the principles of medication administration, infection control, needle and sharps safety, post-exposure prophylaxis, and biomedical-waste disposal. The relationships of KAP domains to participant characteristics were also examined.

METHODS

Study design and setting

A cross-sectional survey was conducted in Sri Madhusudan Sai Institute of Medical Sciences and Research (SMSMSR), Muddenahalli, Karnataka, India. The study targeted nursing faculty and students and aimed to assess their knowledge, attitudes and practices regarding intravenous (IV) injection administration. Convenience sampling was used to recruit participants for a 6-month study period.

Study population and eligibility

The nursing faculty and students were deemed eligible if they were over 18 years of age and willing to participate. Those who refused consent were not included. Responses that did not meet the eligibility criteria were excluded from the statistical evaluation for the present analysis. If more than one eligible submission was from the same participant, the one response was kept as per the prespecified data-cleaning approach.

Data-collection instrument

The information was gathered by means of a structured questionnaire that was filled out electronically via Google Forms. The first part gathered demographic and professional data such as age, gender, department or ward, designation, educational qualification, years of experience and faculty or student group.

The administered KAP instrument consisted of 22 items, 13 of which measured knowledge, seven measured practice, and two measured attitudes. The knowledge questions focused on issues related to safe IV medication administration, such as medication-administration rights, allergy history, hand hygiene, glove use, vein identification, tourniquet use, injection-related complications, post-exposure prophylaxis, biomedical-waste disposal, double gloves, syringe identification, and unsafe injection practices. Practice questions covered topics including explaining the procedure, reusing syringes, hand disinfection, recapping needles, skin disinfection, use of needle-removal or destruction devices, and timely disposal of sharps. The two attitude

questions examined attitudes towards documentation of sharps injuries and the usefulness of vein-finder devices.

Knowledge, attitude and practice scoring

In the knowledge domain, each of the 13 items was judged correct or incorrect based on the analysis answer key that was developed for the questionnaire. The total number of correct answers was used to determine the main knowledge score, which could range from 0 to 13. The number of correct responses was also divided by 13 and multiplied by 100 to get a percentage score. Furthermore, the scoring system used in the protocol (2 points for a correct response and 1 point for an incorrect response) was kept as an additional knowledge score with a theoretical range of 13–26.

Responses were coded in such a way that higher scores always indicated safer behaviour. Responses to positively worded items were coded as Always = 3, Sometimes = 2, and Never = 1. The two items involving undesirable practices (reuse of a syringe after changing the needle and recapping of a used needle) were reverse coded with Never = 3, Sometimes = 2, and Always = 1. The scores of the seven items were added together to give a total practice score of 7 to 21.

Responses were coded as Yes = 3, No = 2, and Not aware = 1, consistent with the protocol, for attitude. The two items were combined to form a total attitude score of 2–6. Higher scores indicated a more positive attitude towards the safety-related attitudes assessed by the questionnaire.

The three KAP domains were analysed independently. No composite overall KAP score was computed, and no post hoc categories (poor, moderate, good) were imposed as these were not defined in the study protocol.

Data preparation

The data set was pre-screened for consent status, age eligibility, data completeness, and multiple submissions before analysis. The analytical file did not contain personal identifiers. Demographic variables were recoded into common categories, but not altered in their substantive meaning, for equivalent free-text responses.

Demographic information that was missing was not excluded from analyses that did not require that information.

Statistical analysis

Categorical variables were presented as frequencies and percentages and are presented as n (%). Continuous variables were expressed as mean and SD and median and IQR as appropriate. The results of the item-level knowledge findings were summarized as correct and incorrect responses. Items of practice and attitude were presented in the same order as the original response categories.

Exploratory comparisons and associations were made using non-parametric procedures because the KAP scores were bounded and ordinally derived. The Mann–Whitney U test was used to compare differences between two independent groups. Spearman's rank correlation coefficient (ρ) was used to assess the relationships between age, experience and KAP scores, and the correlations among the KAP domains.

All statistical tests were two-tailed and a p value of < 0.05 was considered statistically significant. In addition to p-values, the test statistics were also included to facilitate interpretation of the results.

Ethical considerations

The survey was self-selected and respondents were asked to consent to participating in the online survey prior to completing it. Confidentiality of collected information was maintained and only the investigators had access to the information.

RESULTS

Participant characteristics

The analysis included 178 participants. Most were female, $n = 117$ (65.7%), and $n = 174$ (97.8%) were recorded as faculty, while $n = 4$ (2.2%) were students. The median age was 24 years (IQR 23–28; $n = 177$), and the median duration of experience was 1.5 years (IQR 1.0–4.4; $n = 176$). BSc Nursing was the most common qualification, reported by $n = 105$ (59.0%) participants. Participant characteristics are summarized in Table 1.

Table 1. Participant characteristics (N = 178)

Characteristic	Value
Age, years; median (IQR)	24 (23–28); $n = 177$
Experience, years; median (IQR)	1.5 (1.0–4.4); $n = 176$
Gender	
Female	117 (65.7)
Male	61 (34.3)
Role	
Faculty	174 (97.8)
Student	4 (2.2)
Qualification	
BSc Nursing	105 (59.0)
GNM	48 (27.0)
Post Basic BSc Nursing	14 (7.9)

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Characteristic	Value
Other/Unclear	4 (2.2)
MSc Nursing	3 (1.7)
ANM	3 (1.7)
Other Diploma	1 (0.6)
Designation	
Staff Nurse	144 (80.9)
Other/Unclear	14 (7.9)
In-charge/Manager	8 (4.5)
Trainee Nurse	5 (2.8)
Senior Staff Nurse	4 (2.2)
Principal	1 (0.6)
Nursing Administration	1 (0.6)
Missing	1 (0.6)
Department/clinical area	
Surgery/Perioperative	48 (27.0)
Paediatrics/Neonatal	30 (16.9)
Obstetrics &Gynaecology	27 (15.2)
Medicine/Critical Care	24 (13.5)
Cardiac/CTVS	20 (11.2)
Emergency	12 (6.7)
Private Ward	9 (5.1)
Other	5 (2.8)
Nursing/Administration	3 (1.7)

Values are n (%) unless otherwise stated. IQR, interquartile range.

Knowledge regarding intravenous injection administration

The median knowledge score was 9 of 13 correct responses (IQR 8–11), corresponding to a median of 69.2% correct (IQR 61.5–84.6). Correct responses were most frequent for hand-hygiene timing, n = 172 (96.6%),

eliciting drug-allergy history, n = 171 (96.1%), and glass-vial disposal, n = 170 (95.5%). The lowest correct-response frequencies were observed for identification of the vein shown in the questionnaire figure, n = 30 (16.9%), and syringe identification, n = 71 (39.9%) (Table 2; Figure 1).

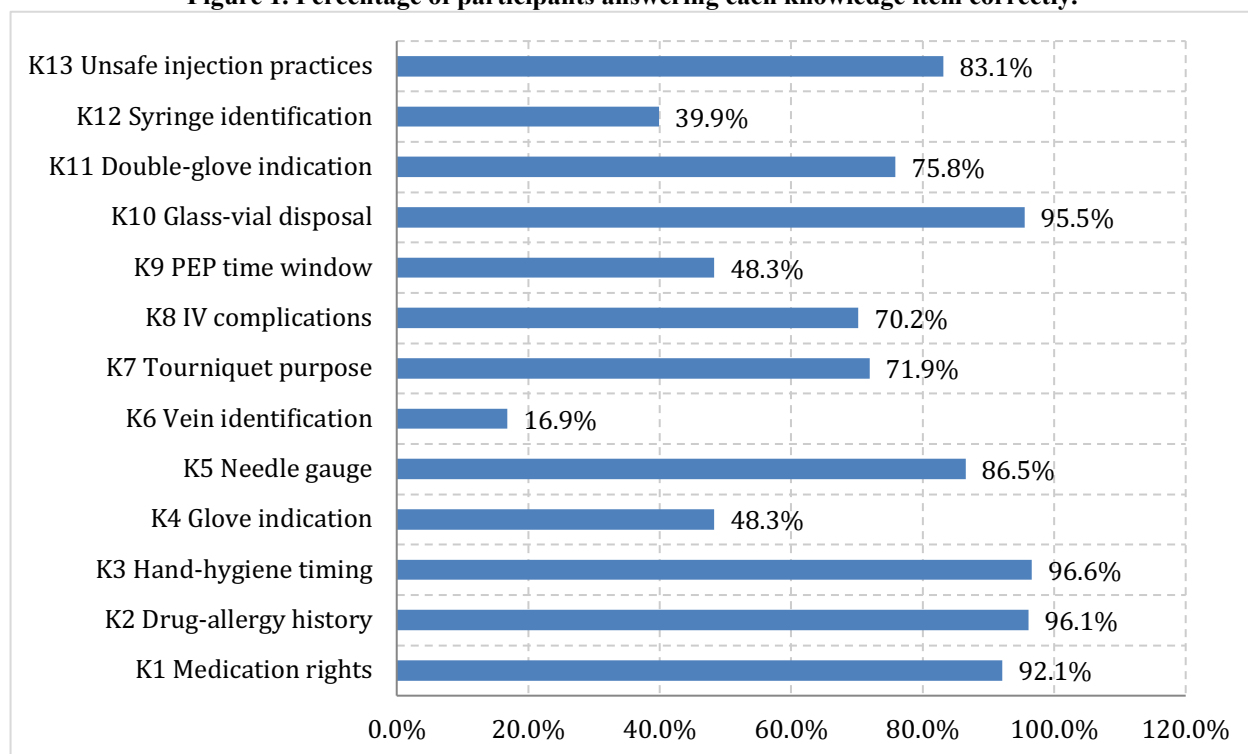
Table 2. Item-wise knowledge regarding intravenous injection administration (N = 178)

Item	Knowledge statement / correct response	Correct, n (%)	Incorrect, n (%)
K1	Medication-administration rights (6 rights)	164 (92.1)	14 (7.9)
K2	Essential history before IV injection (drug allergy)	171 (96.1)	7 (3.9)
K3	Hand hygiene before and after injection	172 (96.6)	6 (3.4)
K4	Indication for glove use (patient skin not intact)	86 (48.3)	92 (51.7)
K5	Preferred gauge for routine IV injection (18–24)	154 (86.5)	24 (13.5)
K6	Identification of vein shown in figure (basilic vein)	30 (16.9)	148 (83.1)
K7	Purpose of tourniquet (distend veins)	128 (71.9)	50 (28.1)
K8	Complications of IV injection (all listed)	125 (70.2)	53 (29.8)
K9	PEP not effective beyond 72 hours	86 (48.3)	92 (51.7)
K10	Glass vial disposal (blue bin)	170 (95.5)	8 (4.5)

Item	Knowledge statement / correct response	Correct, n (%)	Incorrect, n (%)
K11	When double gloves are not used (IV injection with intact skin)	135 (75.8)	43 (24.2)
K12	Identification of syringe shown (standard disposable syringe)	71 (39.9)	107 (60.1)
K13	Unsafe IV injection practices (all listed)	148 (83.1)	30 (16.9)

Percentages are calculated using N = 178.

Figure 1. Percentage of participants answering each knowledge item correctly.



Abbreviation: PEP, post-exposure prophylaxis.

Practice regarding intravenous injection administration

The median practice score was 20 of 21 (IQR 18–21). Immediate disposal of used sharps was reported as always by n = 175 (98.3%), and explaining the procedure

before injection by n = 172 (96.6%). The desired response was least frequent for use of a needle-remover or needle-destroyer, n = 133 (74.7%), and avoidance of recapping used needles, n = 134 (75.3%) (Table 3; Figure 2).

Table 3. Self-reported intravenous injection practices (N = 178)

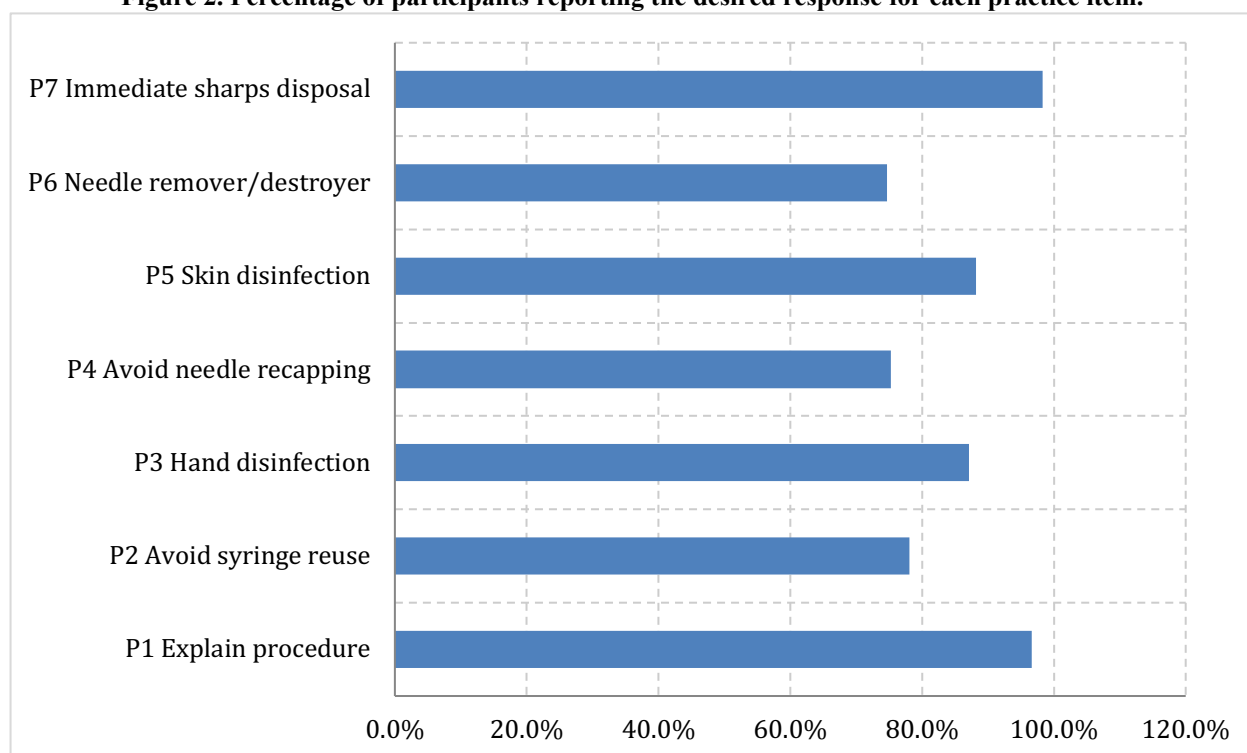
Item	Practice statement	Always, n (%)	Sometimes, n (%)	Never, n (%)	Desired response, n (%)
P1	Explain the IV injection procedure	172 (96.6)	4 (2.2)	2 (1.1)	Always: 172 (96.6)
P2	Reuse a syringe after changing the needle	28 (15.7)	11 (6.2)	139 (78.1)	Never: 139 (78.1)
P3	Disinfect hands before IV injection	155 (87.1)	10 (5.6)	13 (7.3)	Always: 155 (87.1)

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Item	Practice statement	Always, n (%)	Sometimes, n (%)	Never, n (%)	Desired response, n (%)
P4	Recap the used needle and syringe	36 (20.2)	8 (4.5)	134 (75.3)	Never: 134 (75.3)
P5	Disinfect the skin before injection	157 (88.2)	8 (4.5)	13 (7.3)	Always: 157 (88.2)
P6	Use a needle-remover/needle-destroyer	133 (74.7)	25 (14.0)	20 (11.2)	Always: 133 (74.7)
P7	Dispose used sharps immediately into a sharps container	175 (98.3)	1 (0.6)	2 (1.1)	Always: 175 (98.3)

For P2 (syringe reuse) and P4 (needle recapping), the desired response was Never; for all other items, the desired response was Always.

Figure 2. Percentage of participants reporting the desired response for each practice item.



For P2 and P4, the desired response was Never; for all other practice items, the desired response was Always.

Attitude toward injection safety

The median attitude score was 6 of 6 (IQR 5–6). A favourable response regarding maintenance of sharps-

injury records was reported by n = 163 (91.6%) participants, while n = 139 (78.1%) agreed that vein-finder devices help locate veins in adults (Table 4).

Table 4. Attitude responses regarding injection safety (N = 178)

Item	Attitude statement	Yes, n (%)	No, n (%)	Not aware, n (%)
A1	Keeping sharps-injury records facilitates education and prevention	163 (91.6)	9 (5.1)	6 (3.4)
A2	Vein-finder devices help locate veins in adults	139 (78.1)	25 (14.0)	14 (7.9)

KAP domain scores

Overall score distributions were concentrated toward the higher end of the practice and attitude scales. Detailed descriptive statistics for all domain scores are presented in Table 5.

Table 5. Summary of knowledge, attitude, and practice domain scores

Domain	Scale	n	Mean $\pm$ SD	Median (IQR)	Observed range
Knowledge correct	0–13	178	9.21 $\pm$ 1.84	9 (8–11)	3–12
Knowledge percentage	0–100%	178	70.9 $\pm$ 14.1	69.2 (61.5–84.6)	23.1–92.3
Knowledge protocol score	13–26	178	22.21 $\pm$ 1.84	22 (21–24)	16–25
Practice total	7–21	178	19.34 $\pm$ 1.97	20 (18–21)	12–21
Attitude total	2–6	178	5.58 $\pm$ 0.76	6 (5–6)	2–6

SD, standard deviation; IQR, interquartile range.

Exploratory associations

Knowledge showed a weak positive association with age (Spearman ρ = 0.151, p = 0.045). Knowledge scores were also slightly higher among male participants than female participants (median 10 [IQR 8–11] vs 9 [IQR 8–10];

Mann–Whitney U = 2846.0, p = 0.025). Knowledge and practice scores were positively correlated (Spearman ρ = 0.370, p < 0.001). The remaining tested associations were not statistically significant (Table 6).

Table 6. Exploratory associations involving KAP domain scores

Association	n	Group summary, median (IQR)	Test	Statistic	p-value
Age vs knowledge	177	—	Spearman rho	ρ = 0.151	0.045
Age vs practice	177	—	Spearman rho	ρ = 0.145	0.054
Age vs attitude	177	—	Spearman rho	ρ = 0.068	0.372
Experience vs knowledge	176	—	Spearman rho	ρ = 0.147	0.051
Experience vs practice	176	—	Spearman rho	ρ = 0.143	0.058
Experience vs attitude	176	—	Spearman rho	ρ = 0.103	0.172
Gender: knowledge (female vs male)	178	Female 9 (8-10); Male 10 (8-11)	Mann-Whitney U	U = 2846.0	0.025
Gender: practice (female vs male)	178	Female 20 (18-21); Male 21 (19-21)	Mann-Whitney U	U = 3157.0	0.186
Gender: attitude (female vs male)	178	Female 6 (5-6); Male 6 (6-6)	Mann-Whitney U	U = 3396.5	0.505
Knowledge vs practice	178	—	Spearman rho	ρ = 0.370	<0.001
Knowledge vs attitude	178	—	Spearman rho	ρ = 0.103	0.171
Practice vs attitude	178	—	Spearman rho	ρ = 0.017	0.824

All p-values are two-sided. ρ , Spearman rank-correlation coefficient; U , Mann–Whitney U statistic. Knowledge is based on number correct (0–13).

DISCUSSION

The overall pattern of injection-safety practice and attitude in the present study was favourable, but there were important gaps in certain areas of knowledge. The median knowledge score was 9/13 (69.2%), while the median practice score was 20/21. Hand-hygiene timing,

drug-allergy history, and glass-vial disposal were best known, while vein identification, syringe identification, glove indications, and the PEP time window were less well known. Overall, 98.3% of participants reported that they disposed of sharps immediately, 75.3% reported never recapping a needle, and 78.1% reported never

reusing a syringe after changing the needle. There was a positive correlation between knowledge and practice ($p=0.370$), suggesting that higher knowledge was associated with safer practice, although the relationship was not strong.

Similar findings of general awareness alongside gaps in specific safe practices have been reported elsewhere. Adejumo and Dada surveyed 385 nurses in two hospitals in Nigeria and found that 70.4% believed that unsafe injections were associated with blood-borne infection, while 76.1% knew that used needles and syringes should be disposed of in a sharps container. Only 55.9% identified two-handed recapping as unsafe, however, 50.4% had recently experienced a sharps injury and only 15.6% of those injuries were formally reported [9]. In a similar study of 370 physicians and 320 nurses in eight states in the United States, Kossover-Smith et al. reported that syringe reuse for more than one patient occurred in the workplace according to 12.4% of physicians and 3% of nurses, with nearly 5% of physicians reporting that it occurred usually or always [10]. These results corroborate our finding that high overall practice scores do not necessarily exclude a small but clinically significant proportion of unsafe behaviours.

Indian data are useful for providing context. Datta et al. conducted a study of 300 healthcare workers in a tertiary-care hospital in Tripura, of whom 88% were nurses, 77% were in the age group of 18–25 years, and 71.3% were female. Sixty-seven percent of participants reported good injection-safety practices, and factors such as age, professional category, and work experience were significantly associated with safer practices [11]. In our study, age was weakly positively associated with knowledge ($p=0.151$), while experience was not significantly associated with knowledge or practice. This suggests that greater clinical exposure alone may not necessarily lead to better injection-safety competence.

The management of occupational exposure was of particular concern in our cohort, with only 48.3% getting the question about the PEP time window right. Vardhini et al. evaluated 339 nurses and 66 paramedical workers in South India and found that 71.1% of the nurses and 36.4% of the paramedical workers had good knowledge about PEP. The awareness of nurses regarding PEP was high (95.9%) but only 23% of the nurses and 14.3% of the paramedical workers who had needle pricks had taken PEP [12]. This gap between knowledge and action highlights the need for education to be complemented by easy reporting channels and well-established post-exposure procedures.

The overall KAP profile is also similar to that of Buyite et al. who assessed 100 staff nurses in Aurangabad and observed that 64% had an average level of knowledge, 84% had positive attitude and 69% had an average level of injection-safety practice [13]. Care should be taken in

making direct numerical comparisons because we did not establish post hoc categories of “good,” “average,” or “poor.” But both studies indicate that positive attitudes can exist alongside lack of knowledge and actual safety practices.

Sharps handling is another important aspect. In Saudi Arabia, Alsabaani et al. found that 11.6% of healthcare workers had suffered a needlestick injury in the previous 12 months, with over half (52.7%) of these injuries going unreported. While 82.4% recognized that sharps should be disposed of in a proper container and 81.0% knew the procedures to follow after an injury, only 61.2% recognized that recapping a needle is not recommended. In practice, 27.5% said they used two-handed recapping and 97.1% always used designated sharps containers [14]. Immediate disposal of sharps was excellent as in our study, however approximately one-fourth of participants did not always avoid recapping.

Our cohort's positive knowledge–practice relationship differs from the results of direct observation. Dhungana et al. assessed 115 nurses in paediatric units in Nepal who were administering intravenous (IV) medications, and found that only 12.2% had adequate knowledge, 82.6% had poor performance and none had a good performance rating. There was a weak negative correlation between knowledge and practice ($r=-0.202$, $p=0.031$), and only 16.5% had been given specific on-the-job medication-administration training [15]. By comparison, 87.1% of our participants said they always wash their hands before giving IV injections. Some of this difference may be due to methodology, as our practice measures were self-reported while Dhungana et al. used direct observation, making social-desirability bias an important consideration.

Structured improvement programmes can enhance practice as demonstrated in a tertiary-care labour room in India by Pradeep et al. Using a 15-point observational checklist and 12 plan-do-study-act cycles, baseline compliance with safe injection practices increased from 20% to 80% during the intervention. In the first sustainability period, the median compliance was 87%, and then dropped to 67% partly because of resource availability and behavioural issues [16]. The findings suggest that the process of identifying gaps in knowledge is just the first step; continuous improvement might need to be achieved through repeated competency-based training, adequate materials, on-the-job observation and periodic audit.

The study has several strengths. The participants were selected from different clinical settings, the items were analysed separately and knowledge, attitude and practice were measured separately. The single-centre convenience sample, however, does not permit generalizability and only four students were included, with 97.8% of the participants being faculty or staff, making meaningful comparisons between intended

groups impossible. Self-reported practices might overestimate actual practices, and the two-item attitude scale was not very discriminatory. Furthermore, the cross-sectional design and the associations that were not adjusted are not appropriate for causal inferences.

Overall, the results indicate that there is a potential for high levels of self-reported adherence to routine injection safety practices, and clinically relevant gaps in knowledge and practice. Some of the aspects of IV administration (e.g., timing of PEP, avoiding recapping of needles and reusing syringes) remain appropriate for competency-based training, direct observation and audit-based reinforcement.

CONCLUSION

Injection-safety practices and attitudes were generally favourable, but important gaps remained in PEP knowledge, needle recapping, syringe reuse, and selected technical aspects of IV administration. Targeted competency-based training, direct observation, and periodic audit may help strengthen safe injection practices.

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