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Original Article

Evaluating Knowledge Attitudes and Practices Regarding High-Alert Medications among Healthcare Professionals in a Tertiary Care Setting

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Abstract

High-Alert Medications (HAMs) pose a high risk of patient harm if used improperly. This study assessed the knowledge, attitudes, and practices (KAP) of 143 healthcare professionals regarding HAMs at a tertiary care hospital in Palakkad, Kerala. Using a validated bilingual questionnaire, responses from nurses, pharmacists, doctors, and allied staff were analysed. Most participants (79%) were nurses. While positive attitudes (mean: 21.6 ± 2.86) and good practices (mean: 6.4 ± 2.87) were observed, knowledge levels were moderate (mean: 3.2 ± 0.61), with 70% categorized as having low knowledge. Profession showed a marginal association with knowledge ($\chi^2 = 13.78$, $p = 0.055$), but neither attitude nor practice significantly predicted knowledge in logistic regression analysis. Despite favourable attitudes and self-reported practices, limited knowledge, especially among nurses, highlights a critical gap. The findings emphasize the need for profession-specific education to enhance awareness and ensure the safe handling of HAMs.

Keywords: *Healthcare Professionals; High-Alert Medication; Medication Safety; Knowledge Attitude Practice (KAP)*

Introduction

High-Alert Medications (HAMs) are drugs that have an increased potential to cause serious harm to patients if administered incorrectly (ISMP 2024). These include insulin, opioids, anticoagulants, concentrated electrolytes, and neuromuscular blocking agents, all of which demand precise handling, storage, and administration protocols. While errors involving HAMs may not be more frequent than with other medications, the consequences are often more severe, underscoring the importance of stringent safety practices (Joint Commission, 2000; ISMP 2024).

Knowledge, Attitudes, and Practices (KAP) surveys are widely used to assess healthcare professionals' readiness and behaviours in complex clinical domains. These tools are particularly useful in identifying knowledge gaps, evaluating perceptions toward safety, and examining actual practice patterns. In the context of HAMs, such assessments serve as critical inputs for designing targeted interventions to reduce preventable harm (Liao *et al.*, 2022; Chakraborty *et al.*, 2022). Previous KAP studies in areas such as insulin therapy (Mohamed *et al.*, 2024), diabetes management (Hu & Jiang, 2024), and antibiotic use (Mallah *et al.*, 2020) have demonstrated that positive attitudes and reported adherence

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to protocols do not always translate into accurate knowledge or evidence-based practices (Teoh *et al*., 2023).

The World Health Organization's "Medication Without Harm" initiative emphasizes the need for systematic and proactive strategies to reduce medication-related harm, particularly in high-risk situations involving HAMs (WHO, 2017). Countries such as Spain have implemented national-level guidelines and validated KAP instruments to guide rational drug use, particularly in community and institutional settings (Mallah *et al*., 2020). In contrast, Indian literature on HAM safety has primarily focused on urban tertiary centres or limited professional groups, such as pharmacy trainees or resident doctors (Chakraborty *et al*., 2022). This leaves a critical evidence gap in semi-urban or rural settings, where infrastructure, staffing, and ongoing training may differ substantially.

Moreover, nurses, often the last checkpoint in the medication use process, frequently demonstrate strong attitudes and practices but moderate or low knowledge, especially regarding the pharmacology and risk mitigation of HAMs (Hu & Jiang, 2024). These findings highlight the necessity of continuous professional development tailored to the distinct roles within the healthcare team.

This study aims to fill these gaps by evaluating the knowledge, attitudes, and practices of healthcare professionals, including doctors, nurses, and pharmacists in a tertiary care hospital in Palakkad, Kerala. Through a validated, bilingual KAP questionnaire, this study not only quantifies the current status of HAM awareness and safety behaviours but also identifies demographic and professional predictors of high knowledge. The insights gained can inform institutional training frameworks and national policy to strengthen medication safety across all levels of healthcare delivery.

Methodology

A descriptive, cross-sectional survey was conducted to assess the KAP of healthcare professionals regarding HAMs. The study was carried out over a period of three months at a tertiary care hospital located in Palakkad, Kerala, India. The hospital houses multiple clinical departments, including General Medicine, Cardiology, Neurology, Psychiatry, Gastroenterology, Orthopaedics, and Toxicology, where HAMs are frequently prescribed, dispensed, and administered.

Study Population and Sampling

The study population included physicians, nurses, pharmacists, and other allied healthcare staff directly involved in medication-related processes. A convenience sampling method was employed, recruiting participants based on availability and willingness to participate. Inclusion criteria comprised healthcare professionals who were actively engaged in prescribing, dispensing, or administering HAMs. Exclusion criteria included individuals not involved in direct medication handling and those who declined participation.

Data Collection Instrument

Data were collected using a self-developed, bilingual (English and Malayalam) KAP questionnaire, titled "HCPro-HRM KAP Questionnaire" (Healthcare Professionals – High-Risk Medication Knowledge, Attitude, and Practice Questionnaire). The questionnaire consisted of three sections: the Knowledge section included 5 items (2 dichotomous and 3 multiple-choice questions) to assess participants' understanding of high-alert medications (HAMs); the Attitude section comprised 5 statements rated on a 5-point likert scale ranging from 1 (strongly disagree) to 5 (strongly agree); and the Practice section contained 5 items evaluated on a 5-point frequency scale, from 1 (never) to 5 (always), to measure the frequency of safe medication practices. The instrument was pretested for internal consistency, with a Cronbach's alpha of 0.801, indicating good reliability.

Data Collection Procedure

The printed questionnaires were distributed manually to eligible healthcare professionals across departments. Participation was voluntary and their consent was taken orally, and responses were anonymous. Due to the non-interventional, minimal-risk nature of the study, written informed consent

was not used; return of the completed questionnaire was considered implied consent. The study received ethical approval from the Institutional Human Ethics Committee (Approval No. PALIMS/EC/02/23, dated 08.01.2024).

Data Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 21.0. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarise responses. The scoring was categorized into distinct levels for each domain: knowledge was classified as low (scores 0–3) or high (scores 4–5); attitude was categorized as negative (scores 5–12), neutral (scores 13–19), or positive (scores 20–25); and practice was assessed as good (scores 5–12), moderate (scores 13–19), or poor (scores 20–25).

Associations between knowledge levels and professional role, attitude, and practice were examined using the chi-square test. Binary logistic regression was conducted to assess whether attitude and practice scores predicted high levels of knowledge. Statistical significance was set at $p < 0.05$. Binary logistic regression analysis was performed to determine whether attitude and practice scores could predict high knowledge scores, with results expressed as odds ratios (Exp(B)) and 95% confidence intervals.

Results

A total of 143 healthcare professionals participated in the study. The majority were nurses (n = 113; 79.0%), followed by pharmacists (n = 13; 9.1%), doctors (n = 8; 5.6%), pharmacy assistants (n = 3; 2.1%), anaesthesia technicians (n = 3; 2.1%), and nursing assistants (n = 1; 0.7%). One trainee nurse and one trainee pharmacist were also included (each at 0.7%). The predominance of nursing participants reflects their substantial role in patient-facing activities and managing HAMs in clinical settings. The diverse professional composition underscores the multidisciplinary nature of healthcare teams, with each profession playing a distinct role in medication use and patient management (Table 1).

Table 1: *Distribution of Participants by Profession*

Profession	No. of Participants (n=143)	Percentage (%)
Pharmacist	13	9.1
Nurse	113	79.0
Nursing Assistant	1	0.7
Pharmacist Assistant	3	2.1
Doctor	8	5.6
Trainee Nurse	1	0.7
Anaesthesia technician	3	2.1
Pharmacist Trainee	1	0.7

Knowledge, Attitude, and Practice Scores

The overall KAP scores among the participants indicated a moderate level of understanding, a positive outlook, and generally good implementation regarding HAMs. Specifically, participants exhibited moderate knowledge, with a mean score of 3.2 ± 0.61, ranging from 1.0 to 4.0, and a median score of 3.0, suggesting that while they were somewhat familiar with HAMs, there remains room for improvement. In terms of attitude, the findings reflected a positive perception toward HAM safety, with a mean score of 21.6 ± 2.86 (range: 15 to 25; median: 22.0), indicating a strong recognition of the importance of safe handling and administration of these medications. Additionally, the practice scores were generally good, with a mean of 6.4 ± 2.87, a range of 5 to 21, and a median of 5.0, indicating that most participants adhered to appropriate safety measures in clinical practice, although variations in practice quality were noted (Table 2).

Table 2: *Descriptive Statistics of KAP Scores*

Items	Minimum	Maximum	Mean±SD	Median
Total Knowledge score	1.0	4.0	3.2±0.61	3.000
Total Attitude score	15.0	25.0	21.6±2.86	22.000
Total Practice score	5	21	6.4±2.87	5.00

Categorical Distribution of KAP Levels

The distribution of participants' KAP scores is illustrated in Figures 1 to 3. As shown in Figure 1**,** the majority of participants (70%, *n* = 100) were classified as having low knowledge (scores 0–3), while only 30% (*n* = 43) demonstrated high knowledge (scores 4–5). Figure 2 highlights that **77**% (*n* = 110) of participants exhibited positive attitudes toward high-alert medication safety (scores 20–25), whereas 23% (*n* = 33) had neutral attitudes (scores 13–19); notably, none of the participants fell into the negative attitude category. As depicted in Figure 3, the vast majority (95%, *n* = 136) demonstrated good practices (scores 5–12), with 4**%** (*n* = 6) falling into the moderate practice category (scores 13–19), and only 1% (*n* = 1) displaying poor practices (scores 20–25).

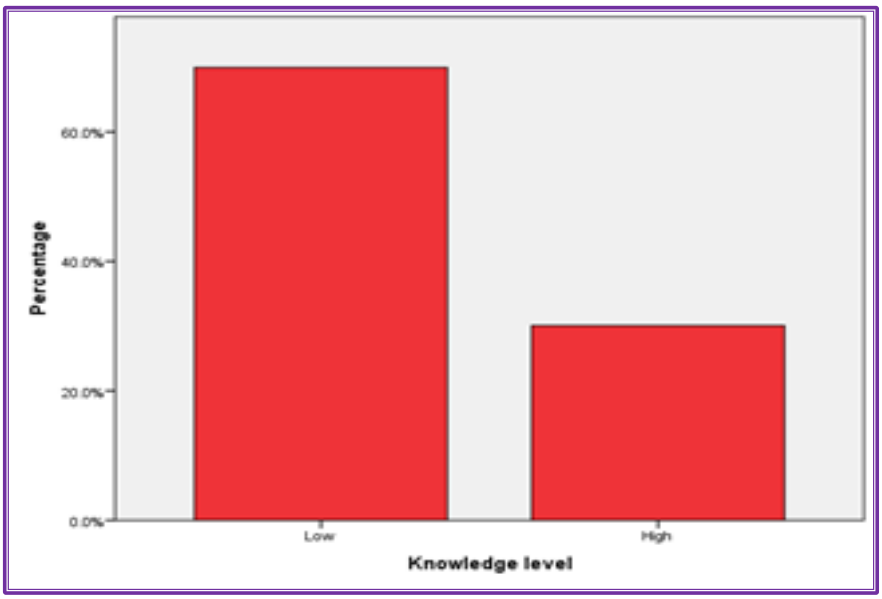

Figure 1: *Distribution of Knowledge Level*

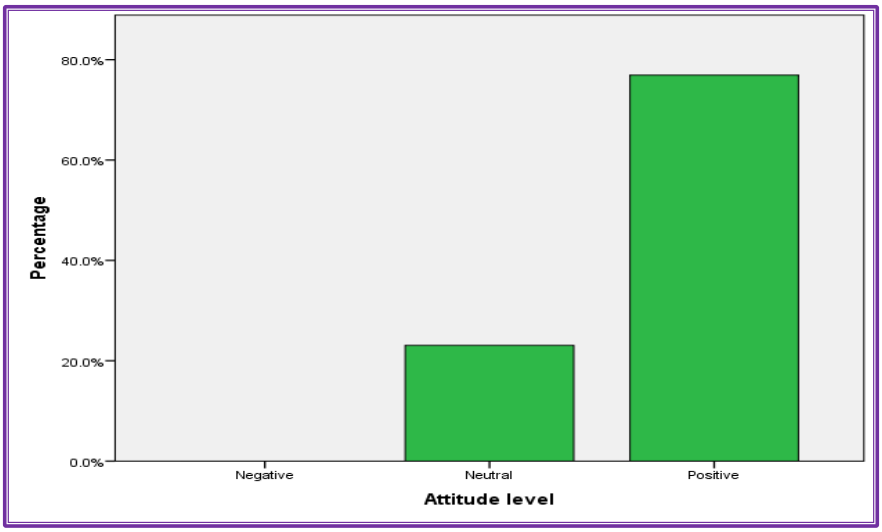

Figure 2: *Distribution of Attitude Level*

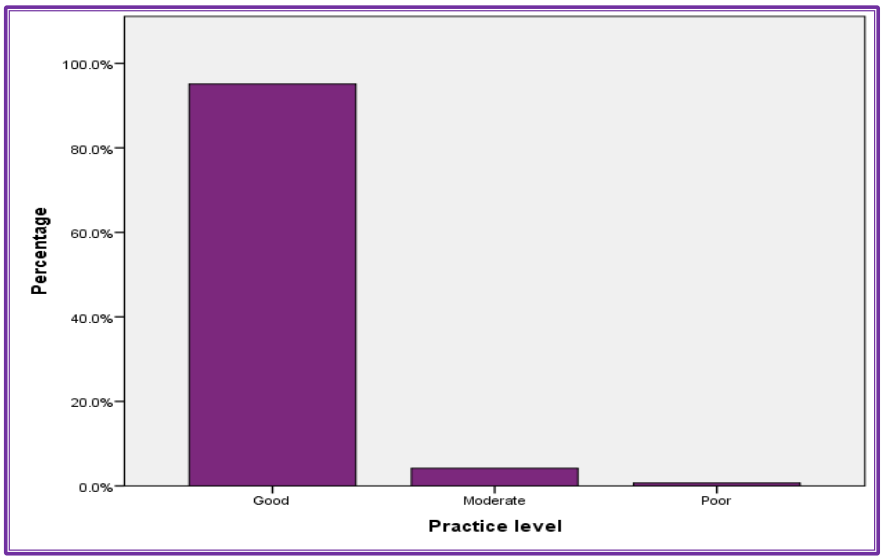

Figure 3: *Distribution of Practice Level*

Association between Profession and Knowledge

Chi-square analysis revealed a marginal association between profession and knowledge level ($\chi^2 = 13.78$, $p = 0.055$), suggesting that knowledge may vary by professional role, although the result did not reach statistical significance. Nurses had the highest proportion of low knowledge scores. No significant associations were found between knowledge level and attitude ($\chi^2 = 2.88$, $p = 0.09$) or practice categories ($\chi^2 = 0.46$, $p = 0.79$), as shown in Table 3.

Table 3: *Associations of Knowledge Level with Selected Variables*

Variable		High	Low	χ^2	*p* value
		n (%)	n (%)		
Profession	Pharmacy Assistant	0	3(2.1)	13.78	0.055
	Anaesthesia Technician	0	3(2.1)		
	Doctor	6(4.2)	2(1.4)		
	Nurse	33(23.1)	80(55.9)		
	Nursing Assistant	0	1(0.7)		
	Pharmacist	3(2.1)	10(7)		
	Pharmacy Trainee	0	1(0.7)		
	Trainee Nurse	1(0.7)	0		
Attitude	Neutral	6(4.2)	27(18.9)	2.88	0.09
	Positive	37(25.9)	73(51)		
Practice	Good	41(28.7)	95(66.4)	0.46	0.79
	Moderate	2(1.4)	4(2.8)		
	Poor	0	1(0.7)		

Predictors of High Knowledge: Logistic Regression

Binary logistic regression analysis was conducted to evaluate whether attitude and practice scores could serve as predictors of high knowledge levels among participants. The results indicated that attitude score was not a statistically significant predictor of high knowledge (B = -0.094, *p* = 0.164; OR **=** 0.911, 95% CI: 0.798–1.039). Similarly, the practice score also did not significantly predict high

knowledge (B **=** 0.016, *p* = 0.813; OR **=** 1.016, 95% CI: 0.892–1.156). These findings suggest that neither attitude nor practice scores were independently associated with higher levels of knowledge in this study population (Table 4).

Table 4: *Logistic Regression Predicting High Knowledge*

Variables	B	S.E.	Wald	DF	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Attitude score	-0.094	0.067	1.936	1	0.164	0.911	0.798	1.039
Practice score	0.016	0.066	0.056	1	0.813	1.016	0.892	1.156

***(B**: Regression Coefficient, **S.E.**: Standard Error, **Wald**: Wald Chi-Square Test, **DF**: Degrees of Freedom, **Sig.**: Significance (p-value), **Exp(B)**: Odds Ratio, **95% C.I.**: 95% Confidence Interval) **

These findings confirm that neither attitude nor practice scores significantly influenced knowledge levels in this sample. These findings highlight the need for targeted educational initiatives to strengthen knowledge about HAMs among multidisciplinary teams.

Discussion

This study sought to assess the KAP of healthcare professionals concerning HAMs within a tertiary care hospital environment. The findings highlight a concerning knowledge gap among healthcare providers, with 70% of participants demonstrating low knowledge scores despite reporting overwhelmingly positive attitudes and generally good medication safety practices. These results echo previous studies in similar healthcare contexts, where positive attitudes alone did not reliably translate into high levels of knowledge or consistent safe practices (Aljadhey *et al*., 2013; Wolf *et al*., 2006).

The predominance of nursing staff among those with lower knowledge levels underscores the importance of targeted educational interventions in this group, who often have the most frequent patient contact and play critical roles in administering HAMs. A study conducted by van Huizen *et al*. (2025) highlights the knowledge gaps among nursing staff regarding hazardous drugs and emphasises the need for targeted educational interventions (van Huizen *et al*., 2025).

While the association between profession and knowledge level approached statistical significance, it did not meet the conventional 0.05 threshold, possibly due to the limited sample size for certain subgroups, such as doctors and pharmacists. Nonetheless, the observed trend suggests that multidisciplinary, profession-specific educational strategies may be warranted (Santos *et al*., 2022).

No significant associations were found between knowledge level and either attitude or practice categories, as confirmed by both chi-square analyses and logistic regression. This finding suggests that while healthcare professionals hold positive attitudes and report good practices regarding HAM safety, these alone are insufficient to ensure adequate knowledge. These findings relate with improving patient safety in Somali healthcare settings, which depicts not only educational initiatives but also system-level interventions, including leadership support, non-punitive error reporting, and strategies empowers frontline staff (Hilowle *et al.* 2025). Previous research has similarly reported that healthcare professionals may follow protocols but lack a sufficiently deep understanding of medication risks, which can undermine patient safety efforts (Alqenae *et al*., 2020; Manias *et al*., 2012). A review indicates that without adequate knowledge, positive attitudes, and self-reported practices alone may not be sufficient to prevent errors (Alsulami *et al*., 2013).

The implications of these findings are particularly relevant in the Indian healthcare context, where medication safety initiatives are gaining traction but still face barriers such as high patient volumes, inconsistent staff training, and gaps in pharmacovigilance reporting. Strengthening in-service education, integrating simulation-based training, and embedding HAM safety principles in continuing professional development programs could help close the knowledge-practice gap identified in this study.

Study Highlights

What is the current knowledge?

- High-Alert Medications (HAMs) pose serious risks when used incorrectly.
- Knowledge, Attitude, and Practice (KAP) studies help assess medication safety awareness.
- Previous studies showed that positive attitudes do not always correlate with sufficient knowledge.
- Most Indian studies on HAMs focus on urban or pharmacy-specific populations.

What is new here?

- Evaluates KAP regarding HAMs across multidisciplinary professionals in a semi-urban tertiary hospital.
- Reveals significant knowledge gaps, especially among nurses, despite good attitudes and practices.
- Identifies the need for profession-specific, structured training to improve HAM safety awareness.
- Uses a validated bilingual KAP tool ensuring local relevance and inclusivity.

Limitations

A major strength of this study is its multidisciplinary sample, which included nurses, doctors, pharmacists, and allied health professionals, reflecting the diversity of roles in HAM handling. The use of a validated, bilingual KAP questionnaire also enhanced the relevance and acceptability of the survey.

However, certain limitations must be recognised. Firstly, the use of convenience sampling could have led to selection bias, which may restrict the applicability of the findings beyond this particular institution. Second, the relatively small sample sizes for certain professional groups (such as doctors and pharmacy trainees) limited the power to detect statistically significant differences. Finally, the reliance on self-reported practices may have overestimated actual safe behaviours due to social desirability bias. These results may not be generalizable to other healthcare settings or geographic regions.

Recommendations

Future research should consider larger, multicentre studies with stratified random sampling to validate and expand on these findings. In addition, incorporating direct observations or audits of HAM-related practices could provide more objective insights. Hospital leadership should prioritize periodic, profession-specific educational interventions and competency assessments to reinforce knowledge and skills around high-alert medication safety.

Conclusion

This study provides important insights into the knowledge, attitudes, and practices of healthcare professionals toward HAMs safety in a tertiary care hospital setting. While participants demonstrated generally positive attitudes and good reported practices, their knowledge about HAMs was found to be moderate overall, with substantial gaps particularly among nurses.

These findings underscore the critical need for targeted, profession-specific educational initiatives and competency-based training programs to strengthen knowledge levels, thereby supporting safer medication practices and reducing the risk of medication-related harm. Implementation of continuous professional development programs and policy-level support will be key to sustaining improvements in HAM safety. Future research with larger, multicentre samples and objective practice audits is recommended to further validate these results and inform policy and practice improvements in high-alert medication safety.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Acknowledgment

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