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Factors Associated with High-Alert Medication (HAM) Knowledge of Pharmaceutical Staff at Tangerang Regional Hospital, Indonesia

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ABSTRACT

Background: High-alert medication (HAM) poses a high risk of causing serious harm to patients when used incorrectly. One of the critical strategies to reduce or prevent medication errors associated with medication is ensuring adequate knowledge among healthcare providers.

Objectives: This study aims to assess knowledge level of pharmaceutical staff regarding HAM in hospital settings.

Methods: An observational, non-experimental design was used with a cross-sectional approach. Data were collected with structured questionnaires and analyzed through multiple linear regression.

Results: A total of 89 respondents participated in the study, of which 97% demonstrated a good understanding of HAM. The mean ± SD value of respondents was 87.97 ± 8.50, while the minimal, maximal, and median values were 64.71, 100, and 88.24, respectively. Multivariate analysis showed that variables such as age, gender, education level of pharmacy technicians, and work experience ($p > 0.05$) were not significantly associated with knowledge level. However, the education level of pharmacists indicated a statistically significant association ($p < 0.05$) with knowledge regarding HAM.

Conclusion: This study found a significant association between the education level of pharmacist staff and knowledge level. Future studies should consider various hospital settings across Indonesia to gain a more comprehensive understanding regarding knowledge level of pharmaceutical staff concerning HAM. Additionally, further investigations are needed to explore the correlation between the incidence of medication errors associated with HAM and knowledge level of pharmaceutical staff.

Keywords: High-alert medication; Knowledge Level; Patient Safety; Pharmaceutical Staff

INTRODUCTION

High-alert medication (HAM) poses a high risk of causing serious harm to patients when used incorrectly.[1] A survey conducted in the United States found that medication errors were largely influenced by human factors, mainly due to insufficient performance and lack of knowledge. [2] Pharmaceutical staff, both pharmacists and technicians (vocational degree), must carefully administer medicines classified as high-alert. Examples of these medication include cytostatic drugs, electrolytes with high concentrations, as well as drug names with similar looks and pronunciations or Look Alike Sound Alike (LASA), anaesthetic agents, insulin, and others. [3–5] High-risk medication, in terms of safe usage in specific situations, carry a significant potential for harm. Although errors associated with HAM may not occur more frequently than those with other drugs, the consequences can be severe for the patient. The risks, the work environment (hospital inpatient settings), organizational culture, and

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clinical situations (emergency and anesthesia situations) may present challenges for healthcare providers in maintaining patient safety while delivering care. Certain conditions specific to vulnerable groups, including pregnant women, children, and the elderly, as well as clinical areas, namely cancer treatment, can increase the risk associated with HAM.[4]

A total of 204 medication errors were reported in previous studies, with prescribing errors accounting for 41.5% (92), followed by documentation 33.8% (69) and administration 21.1% (43). The baseline error rate was 160.12 per 1,000 patient-days. The most frequently implicated HAM were potassium chloride, tramadol, propranolol, aspirin, insulin, and metoprolol. Therefore, one of the essential factors in minimizing or preventing the risk of injury due to HAM is good knowledge about HAM. Pharmacy staff knowledge regarding HAM, such as preparation and distribution, storage, labeling, as well as administration of HAM, is critical. [6] Handayani (2017) found that medication errors related to prescription occurred due to a lack of knowledge and related information. Administration errors can be attributed to a lack of knowledge in using technology to prepare medication, while dispensing errors mostly occur in LASA agents. [7]

Knowledge is potentially influenced by age, gender, work experience, and level of education.[8] A previous study conducted by Athiya et al (2019) found that working experience, age, and standard operating procedures (SOPs) for dispensing and self-medication significantly affected pharmacists knowledge, attitudes, and practices in pharmacy service delivery. [9] Furthermore, Cokro et al. (2022) showed that location of work, age, and gender did not influence pharmacists knowledge regarding beyond-use date (BUD).[10] Aryani et al. (2016) also reported that age, gender, education level, and work experience can influence knowledge of community health center staff in managing medicine products. [11]

A study about knowledge and regulations of HAM in Palestine [12] and Pakistan [13] found that most nurses had insufficient knowledge, and identified a significant association between knowledge and HAM-related training. [12] Another study conducted in the Bekasi Hospital, West Java, Indonesia, regarding knowledge level of pharmaceutical staff on HAM (n = 35) reported a good level of knowledge (92.1%).[14] In the city of Bangkalan, East Java, knowledge of pharmacists (n = 45) regarding HAM was found to be high (>75%). [15] Although several studies have examined knowledge of HAM among healthcare professionals, the results remain inconsistent across countries and professional groups. Previous investigations have also not been conducted on factors related to knowledge of HAM at Tangerang regional hospital. Given that the quality of pharmaceutical staff may vary across healthcare facilities and directly affect medication safety and service quality, further investigation is warranted. Therefore, this study aims to examine factors related to HAM knowledge of pharmaceutical staff at Tangerang Regional Hospital. [16,17]

METHODS

This study used an observational non-experimental design with a cross-sectional method. Data were collected from 42 pharmacists and 47 pharmaceutical technical staff, using total sampling. The location was at Tangerang Regional Hospital (two different hospitals), and the period lasted from March to April 2024. The sample for this study comprised all pharmaceutical staff who worked at the hospital and met the inclusion criteria.

The inclusion criteria were pharmacists and pharmaceutical technical staff who were actively working at the hospital and who were willing to be respondents and fill out the questionnaire. Meanwhile, the exclusion criteria were pharmacists and pharmaceutical technical staff who did not answer the questionnaire completely.

Data were collected by distributing questionnaires using Microsoft Forms. This questionnaire consisted of two parts. The first part contained the identity and characteristics of pharmaceutical staff, while the second part contained questions to measure knowledge related to HAM. The characteristics of pharmaceutical staff examined include age, gender, education level, and work experience. Meanwhile, knowledge questionnaire regarding HAM contained 17 questions, covering definitions, examples, storage and labeling, preparation and distribution, and administration. The questionnaire on knowledge level of HAM was developed with reference to Institute for Safe Medication Practices (ISMP) and pharmaceutical service regulations in hospitals issued by the Ministry of Health of Indonesia. Indonesian government has established regulations governing the storage of Look-Alike Sound-Alike (LASA) medication through the Ministry of Health Regulation No. 73 of 2016 on Pharmaceutical Service Standards in Pharmacies. These guidelines require LASA medication to be stored separately, clearly labeled, and systematically arranged to reduce the risk of selection errors.

A readability test was conducted after the development of the questionnaire to assess the extent to which the questionnaire items could be clearly understood by the respondents, thereby minimizing potential

misunderstandings of the wording used in the questions. The readability test was carried out by two experts, namely professional clinical pharmacists. Each question consists of 2 answers that respondents can select, including yes and no. Respondents were given 1 point when the answer was correct and 0 points when the answer was incorrect. Knowledge score was calculated using the percentage formula:

$$Score = \frac{total\ score}{total\ maximal\ score} \times 100\%$$

Knowledge level category was divided into 3, namely ≤60% (poor), 61–75% (sufficient), and ≥76–100% (good). The validity and reliability of knowledge questionnaire were tested using the Product-Moment method and Kuder-Richardson formula 20 (KR-20) in Microsoft Excel and SPSS. Both tests were carried out on 45 respondents. The questionnaire was considered valid when the calculated r-value> r table (0.294).[18] Meanwhile, the reliability coefficient test was declared good reliability when the value ranged between 0.70 and 1.00. The results from the 17 valid questions related to HAM knowledge showed that KR-20 value was 0.871, indicating high reliability. An analysis of factors, such as age, gender, level of education, and work experience, with knowledge of pharmaceutical staff regarding HAM was carried out using a multiple linear regression test.

RESULTS AND DISCUSSION

The total number of samples was 89, consisting of 42 pharmacists and 47 pharmaceutical technical staff (vocational degree and Bachelor of pharmacy). The demographic characteristics of respondents include age, gender, education level, and work experience, which can be seen in Table 1. Based on the results obtained from filling out the questionnaire, the majority of respondents were aged 21–35 years (66%), female (75 %), and pharmacists (47%), with work experience of 1–5 years (44%).

Table 1. Characteristics of Respondents

Characteristics	N	%	
Age (years)			Mean ± SD = 33 ± 6
21–35	59	66	years
36–45	28	32	Median 31 years
>45	2	2	
Gender			
Male	22	25	
Female	67	75	
Education Level			
Diploma	38	43	
Bachelor	9	10	
Pharmacist	42	47	
Work Experience (years)			
<1 year	1	1	
1–5 years	39	44	
6–10 years	20	22	
>10 years	29	33	

Knowledge level regarding HAM is shown in Table 2. The results showed that pharmaceutical staff knowledge level was mostly good. This is consistent with studies conducted at one of Bangkalan City and Bekasi District Hospital, where the majority of pharmaceutical staff had a relatively good level of knowledge regarding HAM. [14,15] The mean ± SD value was 87.97 ± 8.50, while the minimum, maximum, and median values were 64.71, 100, and 88.24, respectively.

Table 2. Knowledge Level of Respondents

Level of Knowledge	Total		Score
	(n)	(%)	
Low	0	0	Median=88.24
Moderate	3	3	Mean±SD = 87.97±8.50
High	86	97	Min-Max=64.71-100

Most respondents answered correctly regarding HAM question, as shown in Table 3. One of the questions answered incorrectly by many respondents was examples of HAM.

Table 3. Description of the Results of Answers from Respondents Regarding HAM

No.	Questions	Percentage of Correct Answers	Percentage of False Answers
1.	Definition of High-alert medication	99%	1%
2.	*Examples of medication classified as high-alert*	75%	25%
3.	Storage and Labeling of *High-alert medication*	96%	4%
4.	Preparation and Distribution of *High-alert medication*	90%	10%
5.	Administration of *High-alert medication*	98%	2%

Most respondents aged 21–35 years have a good level of knowledge, with the majority being female (73%). Respondents with work experience, either 1–5 years, 6–10 years, and > 10 years, had an equally good level of knowledge, as shown in Table 4. There were no staff members with a low level of knowledge. The majority of pharmaceutical staff with an age range of 21-35 years have a good level of knowledge regarding HAM. The age range of 19–59 years was identified as the productive age to support work productivity and daily activities. [19] Individuals in this age range generally possess stronger cognitive abilities and can perform intensive tasks more effectively. Consequently, higher cognitive capacity is associated with better knowledge level.[20]

Table 4. Distribution of Respondent Characteristics Associated with Level of Knowledge

Characteristics	Level of Knowledge	
	Moderate n (%)	High n (%)
Age (years)		
21–35	3 (3%)	56 (63%)
36–45	0 (0%)	28 (32%)
>45	0 (0%)	2 (2%)
Gender		
Male	1 (1%)	21 (24%)
Female	2 (2%)	65 (73%)
Education Level		
Diploma/Vocational degree	3 (3%)	35 (39%)
Bachelor	0 (0%)	9 (10%)
Pharmacist	0 (0%)	43 (48%)
Work Experience (years)		
<1 year	0 (0%)	1 (1%)
1–5 years	3 (3%)	36 (40%)
6–10 years	0 (0%)	20 (23%)
>10 years	0 (0%)	29 (33%)

The relationship between age, gender, level of education, and work experience with knowledge of pharmaceutical staff regarding HAM is shown in Table 5. Multivariate test results showed that age, gender, educational level, and Work experience did not have a significant relationship (p-value > 0.05) with knowledge regarding HAM. The variable with a substantial relationship with knowledge was found to be the educational level (p-value = 0.0308) with a regression coefficient of 4.4498. Using the vocational pharmacy degree as the reference category, pharmacists with higher educational qualifications showed knowledge scores approximately 4.5% higher than those with a vocational pharmacy background.

Table 5. The Association Factors with Knowledge Level of HAM

Variable	Coefficient	*Standard Error*	*t-statistic*	*p-value*	95% *Confidence Interval* (CI)	
					Lower	*Upper*
Intercept	88.3659	8.7934	10.049	7,75e-16***	70.8665	105.8654
Age (years)						
21–35 years	-	-	-	-	-	-
36–45 years	-0.1933	2.1462	-0.090	0.9285	-4.4643	4.0778
>45 years	2.9741	6.5310	0.455	0.6501	-10.0230	15.9712
Gender						
Male	-	-	-	-	-	-
Famale	-0.1259	2.1280	-0.059	0.9530	-4.3609	4.1090
Education Level						
Diploma/vocational	-	-	-	-	-	-
Bachelor	4.1086	3.1985	1.285	0.2027	-2.2565	10.4738
Pharmacist	4.4498	2.0235	2.199	0.0308*	0.4229	8.4767
Work Experience						
<1 year	-	-	-	-	-	-
1–5 years	-3.1114	8.7251	-0.357	0.7223	-20.4749	14.2521
6–10 years	-3.9499	8.8673	-0.445	0.6572	-21.5965	13.6966
>10 years	-1.5439	8.8209	-0.175	0.8615	-19.0982	16.0103
Regression statistic						
Multiple R-squared	0.07994		*Residual Standard Error*		8.532	
R-squared	0,00639		*F-statistic*		0.8689	
Adjusted R-squared	-0.01207		*p-value*		0.8615	

* = *p-value* < 0,05, significant

Based on the statistical analysis results, age did not significantly correlate with pharmacy staff knowledge regarding HAM. These results are in line with Pranata et al. (2021) and Farhah (2022), who reported that there was no significant relationship between age and knowledge of pharmaceutical staff regarding patient safety. [21,22] This is because all pharmaceutical staff of all ages are required to carry out service standards in hospitals, by improving the safety of HAM to ensure patient safety. Consequently, all health workers, including pharmaceutical staff, must have good knowledge. [3]

The majority of the pharmaceutical staff in this study were found to be women. This result is consistent with Meilianti et al. (2022), who reported that most pharmacists in Indonesia are women. [23] In this study, gender did not have a significant relationship with knowledge regarding HAM. Similarly, Fitriah et al. (2021) and Selifani et al. (2022) found no significant relationship between gender and level of knowledge. [24,25] This is because every health worker, both men and women who work in hospitals, must be able to guarantee patient quality of life by increasing the safety of drugs, specifically HAM.[3]

The hospitals examined in this study were Class C general hospitals, suggesting that at least 1 pharmacist is required as the head of the installation, 2 pharmacists on duty in outpatient care and assisted by least 4 technical staff pharmacy, 4 pharmacists on duty in inpatient care and assisted by at least 8 pharmaceutical technical staff, and 1 pharmacist as reception, distribution and production coordinator who is assisted by pharmaceutical technical staff, depending on the burden of pharmaceutical services. The number of pharmacists and pharmaceutical technical staff employed at the two study hospitals met the minimum human resource standards for Class C general hospitals. [26]

The results showed no significant relationship between the educational level and knowledge. There was a significant relationship between the level of pharmacist education and knowledge related to HAM. These results differ from those of Kristiono et al. (2021) and Yanurrany et al. (2023), who found that the educational level did not have a significant relationship with individual knowledge.[27,28] This is because every pharmaceutical staff, both pharmacists and pharmaceutical technical staff, is required to have the expertise and authority to practice. Authority is the right of pharmacists and pharmaceutical technical staff to practice according to applicable regulations. This expertise and authority must be exercised based on pharmaceutical standards and

Standard Operating Procedures (SOPs) that apply in accordance with the hospital pharmacy installation.[29] Given that pharmacists and pharmaceutical technical staff are required to demonstrate comparable levels of expertise and authority, all pharmaceutical staff must maintain adequate knowledge of HAM. Consequently, the level of formal education may not directly influence knowledge level among pharmaceutical staff, particularly regarding HAM.

Most of pharmaceutical staff in this study had work experience of >1 year and relatively good knowledge regarding HAM. The results are in line with previous studies showing that longer work experience contributes to increased knowledge.[30,31] However, in this study, work experience did not have a significant relationship with knowledge related to HAM. Widodo (2016) and Kristan et al. (2023) also found that work experience had no significant relationship with knowledge.[32,33] This is probably due to all the new pharmaceutical staff in the hospital being required to attend orientation or briefing at the start of the work period. Orientation marks the initial stage of working in an organization to support performance, ensuring new employees can recognize and adapt to the new environment. During the orientation period, an understanding of the main tasks and functions of the organization is provided, and new employees are introduced to the unit to achieve the organization goals. This exercise also makes new employees work more productively, increasing effectiveness and efficiency. [34,35]

Data collected from this study showed that new hospital staff were required to complete orientation before beginning duties in the hospital pharmacy. Orientation at the Hospital is carried out from 2 to 4 weeks. This activity covers the introduction to pharmacy installation and the hospital environment, the main tasks that must be carried out, and the reading of all SOPs. Although there is no special training or provision related to HAM, pharmaceutical staff are required to read a guidebook and ISMP, which contains a list of drugs prescribed and included in HAM. After the orientation period, credentialing is performed. Credentialing is a competency verification process for health workers to determine the suitability of clinical/professional authority. Clinical/professional authority is a competency possessed by every health worker in providing health services that are procedurally guaranteed and safe for patients in a health service facility. [36] In a previous study conducted at RSKIA PKU Muhammadiyah Kotagede (Yogyakarta), participants were given training and education. The results showed that respondents felt more knowledgeable after being given training, giving rise to a positive attitude in handling the application of HAM.[37]

The majority of respondents demonstrated a good level of knowledge, as reflected in questionnaire responses assessing pharmaceutical staff understanding of HAM. The average proportion of correct responses reached ≥90% in the domains of definition, storage and labeling, preparation and distribution, as well as administration of HAM. However, the total average correct answer was found to be only 75%, which means knowledge was considered sufficient, possibly due to the extensive list of medication included in HAM in ISMP.[38] Moreover, not all HAM listed in ISMP are available in all hospitals because each has a specific drug formulary, which has been adjusted to the use of frequently used medication and reviewed based on disease patterns. This can cause errors in answering questions related to HAM examples. [39]

This study has several limitations, first, the assessment of pharmaceutical staff knowledge of HAM was limited to two hospitals in Tangerang area, which restricts the generalizability of the results to other hospitals in Indonesia. Second, this study did not analyze the relationship between the incidence of medication errors associated with HAM and pharmacists knowledge level. Therefore, future studies should evaluate pharmaceutical staff knowledge and practices regarding the storage of HAM.

CONCLUSION

In conclusion, most pharmaceutical staff had good knowledge about HAM. Age, gender, educational level of pharmaceutical technical staff (vocational degree and Bachelor of pharmacy), and work experience did not have a significant relationship with knowledge. In contrast, the level of pharmacist education had a significant relationship with knowledge level about HAM. These results underscore the importance of targeted educational programs and continuous professional development, particularly for pharmacists, to ensure safe handling and management of HAM. For hospital practice, this suggests that tailored training interventions could further enhance medication safety and reduce the risk of errors. Additionally, future studies should explore other organizational, environmental, or behavioral factors that may influence pharmaceutical staff knowledge and adherence to HAM protocols, as well as the effectiveness of structured training programs in improving both knowledge and practice.

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STATEMENT OF ETHICS

This study was approved by the ethics committee of the School of Medicine and Health Sciences at Atma Jaya Catholic University of Indonesia with the issued ethics number No.12/03/KEP-FKIKUAJ/2024.

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