Original Article

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Reliability of High-Alert Medications Questionnaire in Turkish Healthcare Professionals

Sağlık Çalışanlarında Yüksek Riskli İlaç Bilgi Anketinin Güvenilirliği

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ABSTRACT

Objective: This study aimed to evaluate the reliability of the High-Alert Medications (HAM) Questionnaire in Turkish healthcare professionals.

Methods: This methodological study was conducted between December 2017 and January 2018 in a private university hospital. The healthcare professionals, including nurses, health service technicians, and pharmacists, who are older than 18 years old were eligible for this study. After following the appropriate translation and cultural adaptation process, the internal consistency of the HAM Questionnaire using the Kuder-Richardson 20 coefficient and test-retest reliability was evaluated.

Results: Among 146 healthcare professionals, the mean age was 25.40±5.16 years, wherein 76% were females. Most participants were nurses (69.9%) and other healthcare professionals were health service technicians (28.1%) and pharmacists (2.0%). The mean total score of the HAM Questionnaire was 70.00±19.50. The Kuder-Richardson 20 was 0.815. A statistically significant correlation was found between the scores of the HAM Questionnaire at baseline and after 15 days, which confirmed the test-retest reliability (r=0.527; p<0.01). A statistically significant correlation was found between the HAM Questionnaire score and advanced age (r=0.310; p<0.001) and higher professional year (r=0.445; p<0.001).

Conclusion: The Turkish version of the HAM Questionnaire could

ÖZ

Amaç: Sağlık çalışanlarında Yüksek Riskli İlaç Bilgi Anketi'nin anketinin güvenilirliğinin değerlendirilmesi amaçlanmaktadır.

Yöntemler: Bu metodolojik çalışma Aralık 2017 ile Ocak 2018 tarihleri arasında özel bir üniversite hastanesinde gerçekleştirilmiştir. Çalışmamıza 18 yaşından büyük hemşireler, sağlık teknisyenleri ve eczacılar dahil edilmiştir. Uygun çeviri ve adaptasyon sürecini takiben, Kuder-Richardson 20 katsayısı kullanılarak yüksek riskli ilaçlar hakkında bilgi anketinin iç tutarlılığı ve test-tekrar test güvenilirliği değerlendirilmiştir.

Bulgular: Çalışmamıza dahil edilen 146 sağlık çalışanının yaş ortalaması 25,40±5,16 olarak hesaplanmış ve katılımcıların %76'sı kadındır. Katılımcıların meslekleri, hemşire (%69,9), sağlık teknisyenleri (%28,1) ve eczacıdır (%2). Sağlık Çalışanlarında Yüksek Riskli İlaç Bilgi Anketi'nin toplam puan ortalaması 70,00±19,50 olarak hesaplanmıştır. Anket güvenilirliği için Kuder Richardson 20 değeri 0,815 olarak bulunmuştur. Test-retest güvenilirliğini doğrulamak için, başlangıçta ve 15 gün sonra Yüksek Riskli İlaç Bilgi Anketi puanları arasında istatistiksel olarak anlamlı bir korelasyon bulunmuştur (r=0,527; p<0,01). Sağlık Çalışanlarında Yüksek Riskli İlaç Bilgi Anketinin puanı ile ileri yaş (r=0,310; p<0,001) ve mesleki tecrübe yılı (r=0,445; p<0,001) arasında istatistiksel olarak anlamlı bir korelasyon bulunmuştur.

Sonuç: Sağlık Çalışanlarında Yüksek Riskli İlaç Bilgi Anketinin

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be used to assess healthcare professionals' knowledge about high-alert medications.

Keywords: High-risk medication, healthcare professional, medication safety, pharmacist, nurse, knowledge

Türkçe versiyonu sağlık çalışanlarının yüksek riskli ilaçlar hakkındaki bilgilerini değerlendirmek için kullanılabilir.

Anahtar Sözcükler: Yüksek riskli ilaçlar, sağlık çalışanları, ilaç güvenliği, eczacı, hemşire, bilgi seviyesi

Introduction

The Institute for Safe Medication Practices (ISMP) has been published and periodically updated a list of high-alert medications (HAM), which are defined as medications that could cause significant patient harm when erroneously used in variable settings. The HAM list was determined through ISMP Medication Errors Reporting Program, current literature, and input from practitioners and safety experts (1). HAM has a narrow margin of safety or causes severe adverse events. The frequency of medication errors related to HAM varies. Previous studies revealed that medication errors were due to HAM with a rate of 55% (2) and 33% (3). Medication errors with these medicines may lead to devastating consequences, such as death (4).

Insufficient knowledge about HAM was one of the significant causes of medication errors (5,6). Health care professionals should be aware of the risks of HAM and develop strategies to improve safety about the administration of such medications. Knowledge improvement of healthcare professionals by developing educational interventions would be one of the strategies to reduce the risk of HAM. Therefore, the assessment of knowledge related to HAM is essential and is required when developing and implementing educational training programs about HAM for healthcare professionals (7,8).

To our best knowledge, there is no reliable scale in Turkish to evaluate the knowledge of healthcare professionals regarding HAM. Therefore, this study aimed to evaluate the reliability of the HAM Questionnaire; which is developed by Hsaio et al. (9), in Turkish healthcare professionals.

Method

This methodological study was conducted between December 2017 and January 2018 in a private university hospital. The study population includes healthcare professionals who have a direct responsibility in preparing and applying medications (nurse, pharmacist, and health service technician) aged over 18 years old and who worked in a 350-bed private university hospital located in Istanbul, Turkey. According to previous studies (10,11), the minimum sample size was determined as 200. Convenience sampling was used for selecting the study population. Self-reported survey tools were distributed to all participants and collected within the week. The ethical committee approval was obtained from Acıbadem Mehmet Ali Aydınlar University with approval number of 2017-18/9. An informed consent form was obtained from all participants.

Demographic and professional data and their self-assessment regarding their knowledge level and training needs about HAM have been collected. The HAM Questionnaire was generated in Taiwan, and the Turkish version was adapted with permission from the developers (9). It includes a total of 20 items regarding basic and important knowledge of HAM usage. This questionnaire consisted of items regarding administration, delivery route and dosage of medications, and medication regulation. Each item was ranked as true or false by participants. After the true and false/unknown responses scored as 1 and 0, respectively, the total score was multiplied by 5. The minimum and maximum scores were ranged from 0 to 100. The higher score represented better knowledge of HAM (9). The Turkish translation and cultural adaption have been performed before applying the questionnaire to the participants based on the World Health Organization guidelines (12). The original questionnaire included a high concentration of potassium chloride, which was not available in Turkey. This concentration was substituted with the highest concentration of potassium chloride available in Turkey.

Statistical Analysis

The descriptive statistic was represented with number and percentage and mean with standard deviation or standard error of the mean, as appropriate. The Kuder-Richardson test, which is more appropriate for questionnaires with a dichotomous response, was used for internal consistency. According to the findings of the Kolmogorov-Smirnov test, the Spearman correlation was performed between the total score of the questionnaire and other continuous variables, such as age, a profession of health care, and test-retest score. The Mann-Whitney U test for two independent groups, such as age and profession, and the Kruskal-Wallis test for more than two groups, such as education level, perception of knowledge level, and necessary training for HAM, was conducted to compare the total knowledge score between each group. The statistical significance was obtained if the p-value was <0.05.

Results

Among the 200 distributed questionnaires, 159 were returned, and among the 159, 13 had missing data. Thus, the analysis was done in 146 fully-filled questionnaires. The mean age was 25.40±5.16 years. Of them, 76.0% were female. The rate of nurses, pharmacists, and health service technicians were 69.9%, 2.0%, and 28.1%, respectively. Of them, 47.3% had a bachelor's degree. Participants worked in various wards and 45.2% of them worked in the surgery ward. The mean professional experience years were 3.29±5.05 (minimum-maximum: 0-37).

The demographic and professional experience of health care professionals was presented in Table 1.

A moderate correlation was found between the scores of the HAM Questionnaire at baseline and after 15 days, which confirm the test-retest reliability (r=0.527; p<0.01). The internal consistency reliability was acceptable (Kuder-Richardson 20: 0.815). If the item was deleted, the Kuder-Richardson 20 ranged from 0.798 to 0.821. The mean total score was 70.00±19.50. Most participants gave the correct response to the following items: "for convenience, heparin and insulin should be stored together in the refrigerator" (89.7%), "7.5% KCl is frequently used, thus it should be easily and freely accessed by nurses" (91.1%), and "for pediatric dose, use teaspoon for dose expression" (89.7%). Most participants did not give the correct response for the questions about dose calculation for chemotherapy (75.3%), fast IV push 10% calcium chloride at 10 mL in 1-2 min when an emergency happens (63.7%), and potassium can be administered orally instead of IV route if patients can tolerate (62.3%). The rate of correct responses to each item in the questionnaire, corrected item-total correlation, and Kuder-Richardson 20 coefficients if item deleted was presented in Table 2.

Of them, 65.1% agreed that their knowledge was sufficient, and 63.7% agreed to the need for training about HAM. The participants' self-assessment on their knowledge level and training needs about HAM is presented in Table 3.

Increased age was moderately correlated with higher knowledge level (r=0.310, p<0.001). More professional experience also moderately correlated with higher knowledge level (r=0.445, p<0.001) (Table 4).

Table 1. Demographic and professional experience of health care professionals (n=146)

Age (mean ± standard deviation)	25.40±5.16
Female n (%)	111 (76.0%)
Male n (%)	35 (24.0%)
Health care professional n (%)	
Nurse	102 (69.9%)
Health service technician	41 (28.1%)
Pharmacist	3 (2.0%)
Education n (%)	
High school	35 (24.0%)
Two-year degree	37 (25.3%)
Bachelor of science	69 (47.3%)
Specialist	5 (3.4%)
Workplace n (%)	
Surgery	66 (45.2%)
Intensive care unit	41 (28.1%)
Internal medicine	17 (11.6%)
Pharmacy	15 (10.3%)
Emergency department	4 (2.7%)
Missing data	3 (2.1%)
Professional experience (years) (mean ± standard deviation)	3.29±5.05

Male participants had a higher knowledge score compared with the females. However, this difference was not found statistically significant (p>0.05). No statistically significant difference was found between the groups based on their education level (p>0.05). Participants who thought they had sufficient knowledge about HAM had a higher knowledge score compared to participants who did not (p<0.01). No statistically significant difference was found between the groups based on their opinions regarding training need for HAM (p<0.05). Factors related to their knowledge about HAM was presented in Table 5.

Discussion

After the test-retest analysis and assessment of the Kuder-Richardson 20 value, the Turkish version of the HAM Questionnaire could be used to assess the knowledge of healthcare professionals about HAM. Relationships were found between their HAM-related knowledge and advanced age and higher professional year.

The Kuder-Richardson value of the original HAM Questionnaire was found as 0.74 in the previous study (9). Similar to Hsaio et al.'s (9) study, the internal reliability of the Turkish version of the questionnaire is sufficient to evaluate the knowledge levels of healthcare professionals in Turkey. Similar to our study, Hsaio et al. (9) also found a correlation between their HAM-related knowledge level and age and experience. In their study with increasing age and experience, HAM-related knowledge was also increased.

One of the most common wrong responses about HAM in our study was the intravenous (IV) administration of electrolytes, such as 3% NaCl, 7.5% KCl, 10% Ca-gluconate, and 10% CaCl. Our findings were similar to other studies in the literature (9,13,14). Hsaio et al. (9) pointed out that 30% of nurses were administrating electrolytes in an improper way. The present study revealed that almost half of the healthcare professionals gave accurate responses to the question of "Fast IV infusion of 3% NaCl of 500 mL for patients who have low sodium level," which is similar to Zyoud et al. (13) results, where they pointed out that only 50.4% of participants were able to answer correctly.

It is well-known that 7.5% KCl should not be stored in the wards or nursing units and free access to 7.5% KCl should be discouraged (9,13,14). This recommendation was made because IV bolus administration may cause fatal outcomes (9,13-15). Contrarily, our participants agreed with keeping 7.5% KCl away in easily accessible places and 91.1% properly respond to these questions (9). Zyoud et al. (13) revealed that 76.8% of nurses agreed with not administering the 7.5% KCl as fast IV push. Contrarily, Hsaio et al. (9) revealed that only 46.9% of participants were familiar with this warning. Similar to the study conducted by Hsaio et al. (9), our study revealed that 58.9% of participants were able to correctly answer the question regarding 7.5% KCl as fast IV push. Additionally, the Turkish healthcare professionals had much lower knowledge about calcium-containing solutions compared with their knowledge about sodium and potassium-

Table 2. The rate of correct response to each item in the questionnaire, corrected item-total correlation, and Kuder–Richardson 20 coefficients if item deleted

	Correct response	The rate of correct response (%)	Corrected item-total correlation	Kuder-Richardson 20 coefficients if item deleted
"cc" or "mL" is the dosage expression for insulin injection"	F	80.1%	0.544	0.799
"When an emergency, such as ventricular fibrillation happens, push fast 7.5% KCl at 10 mL into IV"	F	58.9%	0.540	0.798
"Fast IV infusion of 3% NaCl of 500 mL for patient who has low sodium level"	F	51.4%	0.483	0.802
"Port-A route can be used for blood withdrawal and drug injection generally"	F	84.2%	0.277	0.813
"Insulin syringe can be replaced by 1 mL syringe"	F	84.9%	0.317	0.811
"Fast IV push 1:1000 epi at 1 amp for patient who has mild allergic reaction"	F	63.7%	0.559	0.797
"10% Ca-gluconate and 10% $CaCl_2$ are the same drug and interchangeable"	F	74.0%	0.518	0.800
"7.5% KCl better added to Ringer's solution for rapid infusion"	F	52.1%	0.532	0.798
"When an emergency happens, fast IV push 10% $CaCl_2$ 10 mL in 1-2 minutes"	F	36.3%	0.488	0.801
"For chemotherapy dose calculation in adult is based on BW, whereas BSA in children"	F	24.7%	0.133	0.821
"Taken fentanyl skin patch as regulated narcotic"	T	82.9%	0.208	0.816
"Use distinctive labeling on look-alike drugs"	T	93.2%	0.012	0.821
"For convenience, heparin and insulin should be stored together in the refrigerator"	F	89.7%	0.400	0.808
"Use "Amp" or "Vial" for dose expression instead of "mg" or "gm"	F	87.7%	0.483	0.804
"If a ward stores atracurium for tracheal intubation, the drug should be stored with other drugs and easily accessed by nurses"	F	71.2%	0.369	0.808
"7.5% KCl is frequently used, so it should be easily and freely accessed by nurses"	F	91.1%	0.410	0.808
"If the patient can tolerate, potassium can be administered orally instead of IV route"	T	37.7%	0.264	0.815
"Each drug better has multiple concentrations for nurse to choose"	F	79.5%	0.375	0.808
"For pediatric dose, use teaspoon for dose expression"	F	89.7%	0.277	0.812
"Use 'U' instead of 'unit' for dose expression"	F	67.1%	0.396	0.807

T: True, F: False, KCl: Potassium chloride, Ca: Calcium, NaCl: Sodium chloride, Epi: Epinephrine, $CaCl_2$, Calcium chloride, IV: Intravenous, BW: Body weight, BSA: Body surface area

Table 3. The participants' self-assessed knowledge level and training needs on high-alert medications (n=146)

	Strongly agree/agree n (%)	Neither agree nor disagree n (%)	Strongly disagree/disagree n (%)
Knowledge level	95 (65.1%)	34 (23.3%)	17 (11.6%)
Training need	93 (63.7%)	29 (19.9%)	24 (16.4%)

Table 4. Correlation between total knowledge score and age and professional experience

	Total knowledge score Spearman's rho-correlation coefficient (r)
Age (years)	0.310***
Professional experience (years)	0.445***

***p<0.001

containing solutions. Our results were consistent with the literature in terms of fast IV administration of $CaCl_2$ (13,16). Additionally, less than one-third of them were not aware that Ca-gluconate and $CaCl_2$ are not interchangeable, which was also consistent with the literature (13,16).

Hypoglycemic effects of insulin put insulin into the HAM list. Due to specific features, insulin should be expressed in units and a 1 mL syringe should be used during administration. The present study revealed that the majority of participants gave an accurate

Table 5. Factors related to their knowledge about high-alert medications (n=146)

	n	HAM Questionnaire score (mean ± SEM)	p-value
Gender			
Female	111	69.46±1.84	
Male	35	71.71±3.41	>0.05
Education			
High school	35	69.86±3.32	
Two-year degree	37	71.89±3.66	>0.05
Bachelor of science degree/specialist	74	69.12±2.11	
Knowledge level regarding high-alert medication			
Strongly agree/agree	95	74.05±1.92a*	
Neither agree nor disagree	34	63.38±2.91b*	<0.05
Strongly disagree/disagree	17	60.59±5.49b*	
Training need for high-alert medications			
Strongly agree/agree	93	68.12±2.01	
Neither agree nor disagree	29	72.76±3.33	>0.05
Strongly disagree/disagree	24	73.96±4.39	

SEM: Standard error of the mean, *there was statistically significant difference between different letters

response for insulin dosage and administration. A concordance was found compared with previous studies (9,13). Additionally, the abbreviation 'U' should be used instead of the unit to prevent misreads such as "0," "11," or "cc" (9,17).

Chemotherapeutical medications are considered one of the most toxic and harmful medications. Medication errors in a chemotherapeutical medication, such as paclitaxel, vincristine, cisplatin, etc., or even dose calculation mistakes may cause devastating results. Our results obtained the lowest correct response rate with chemotherapeutical calculation. Only almost one-fourth of them were aware that during the dose calculation of chemotherapy, the body surface area should be used in adults, whereas the bodyweight for children. Our findings were in-line with previous studies (9,13).

Medication errors are common and life-threatening. Thus, HAM usage and administration need comprehensive knowledge and perception level (18). Medication errors related to HAM may be fatal (19). The evaluation of HAM-related knowledge of nurses, pharmacists, and prescribers, most did not receive any education about HAM during their education and the rest who were educated about HAM were firstly educated during the job training (19). Lack of education and knowledge about HAM increases medication error incidence and patient harm (9,19,20). In this study, more than half of the healthcare professionals agreed to the need for education regarding HAM, which suggests continuing education programs. A follow-up study made by Sullivan et al. (8) revealed that the education program and labeling of HAM increased the knowledge and perception level of healthcare personnel. This education should be executed in nurses, pharmacists, and prescribers. In addition to education, other environmental resources, such as safeguards, should also be reinforced. Systematic risk reduction strategies should be applied, such as barcode medication administration and/or computerized physician order (19).

A randomized controlled trial showed that interventions to prevent medical errors were statistically significant (7). After 1 hour of education about HAM, participants were able to get significantly better results compared with the control group. Furthermore, participants of this education were more motivated, self-confident, and had increased awareness about HAM administration and handling (7).

Identifying the barriers, which let healthcare professionals commit medical errors, is important to prevent the medical errors and cope with them. In the literature, the most common barriers that healthcare professionals encounter are listed as conflicting opinions between the pharmacist, nurse, and prescriber, confused perception, and illegible prescriptions while administering HAM (13,17).

The solution to these problems between pharmacists, nurses, and physicians includes improving communication skills, reliable documentation, computerized drug systems, and supervision. Each institution needs standard operating procedures for the handling and administration of HAM (13,21). These standard operating procedures should be modified according to the need of the institution and regularly updated according to evidence-based data. In addition to standard operating procedures, increased safeguards, a structured interprofessional education, should be ensured regularly for the healthcare worker.

Study Limitations

Our study had some limitations. The generalizability of the results is limited as the sample was taken from a single center. The

distribution of sample size mostly consisted of nurses. Another limitation was that the study findings were based on a reliability study rather than an observational study.

Conclusion

To the best of our knowledge, this is the first study, which evaluated the reliability of a HAM Questionnaire in Turkish healthcare professionals. Institution-specific education and operating model should be created to prevent medication errors. Prevention of medication errors and patient safety should be assured by a collaborative multidisciplinary team, including the clinical pharmacists, nurses, and physicians. A clinical pharmacist should be in charge of medicine use and administration and also supervise the whole process in each unit.

Education and training of healthcare professionals should be placed in the undergraduate curriculum and also maintained with continuing education programs. A system containing standard operating procedures, regular audit, and supervision should be constituted within every institution. Additionally, the administration of safe storage and dispensing of HAM should also be regulated.

Ethics

Ethics Committee Approval: The ethical committee approval was obtained from Acıbadem Mehmet Ali Aydınlar University with approval number of 2017-18/9.

Informed Consent: An informed consent form was obtained from all participants.

Peer-review: Externally peer reviewed.

Authorship Contributions

Concept: F.Ö., Ö.A., M.S., B.O., Design: F.Ö., M.S., B.O., Data Collection or Processing: F.Ö., Analysis or Interpretation: Ö.A., M.Y.B., B.O., Literature Search: Ö.Ö., B.T., M.Y.B., B.O., Writing: F.Ö., Ö.A., B.T., M.Y.B., M.S., B.O.

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