

Comparison across 12 countries on knowledge, attitude, and behavior scores about medication errors in Intensive Care Units: an international study

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Abstract. – OBJECTIVE: The aim of the study was to explore the degree of agreement of intensive care unit nurses working on a set of medication error preventive strategies and to examine possible predictors of nurses' knowledge, attitude and behavior.

MATERIALS AND METHODS: Observational, international, and cross-sectional study. Iran, Malta, Spain, Pakistan, Nepal, Qatar, Ecuador, Australia, Finland, Italy, Egypt, and Jordan were the countries included in this survey. To collect data, the Knowledge, Attitude and Behavior in Medication Errors questionnaire was used. A descriptive statistical analysis was performed for the socio-demographic characteristics of the

sample and three multiple logistic regressions were performed.

RESULTS: The international sample consists of 1383 nurses, of whom 478 (34.6%) were men and 900 (65.1%) were women and their mean age was 35.61 years with a range of 19-61. Descriptive statistics conducted on the international sample show a medium to high degree of agreement among participants concerning some preventive strategies of medication error. In addition, the results of the present study show a strong relationship between positive nurses' attitudes and correct behaviors and/or adequate knowledge, as well as between adequate knowledge and correct behaviors ($p < 0.01$).

CONCLUSIONS: Further studies are needed to explore the issue of medication error concerning nurses' cultural backgrounds, as well as to assess similarities and disparities among international nurses.

Key Words:

Medication errors, Cross-cultural comparison, Instrument, Nursing, Nurses.

Introduction

Medication error (ME) is defined by the National Coordinating Council for Medication Error Reporting and Prevention¹ as “any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer”. According to literature, the main causes of MEs could be related to personal or organizational factors (such as fatigue, stress, cognitive workload, poor interprofessional communication, lack of attention, low job satisfaction, confusion, and flawed decision-making)². About these, several authors^{3,4} have studied how nurses' poor knowledge, negative attitudes and incorrect behaviors could lead to MEs. Based on these factors, several authors focused their attention to develop a new instrument to assess medication knowledge, skills or competency to prevent MEs^{5,6}. Among them, Di Muzio et al^{7,8} have developed and validated an instrument: the “Knowledge, Attitude and Behavior (KAB) in Medication Errors questionnaire”. This instrument aimed to describe and assess nursing knowledge, attitude and behavior about some strategies to prevent MEs in Intensive Care Units (ICUs). Content validity and psychometric properties of the instrument were tested in several countries, such as Italy, Spain and Iran^{3,9,10}.

Despite the growth of literature on MEs, to this date, there is no univocal definition of ME and no standardized methods for its measurement¹¹. In addition, the analysis of the contexts in which the primary studies were conducted shows a strong numerical disparity between the productivity of different countries on MEs. This observation agrees with a recent systematic review that highlights the need to analyze the MEs – their incidence and etiological factors – in relation to the cultural background¹². Indeed, to this date, there is not an international study that has assessed the strategies to prevent MEs among international nurses.

Materials and Methods

Aims

This study aimed to explore the degree of agreement between nurses working in international ICUs about a set of strategies used to prevent MEs. Specifically, the goal of this study is to describe and measure knowledge, attitude, and behavior scores in international healthcare settings. This study aimed also to explore the predictive role of some variables in relation to nursing knowledge, attitude, and behavior scores.

Design and Participants

This is an observational, international and cross-sectional study. The study reporting was according to the STROBE checklist¹³.

To contact researchers who studied the ME phenomenon all over the world, we posted a call to recruit researchers interested to participate in our study on social network ResearchGate. Iran, Malta, Spain, Pakistan, Nepal, Qatar, Ecuador, Australia, Finland, Italy, Egypt and Jordan are the country included in this study. In each country included, the authors established clear criteria to include or exclude participants. Specifically, nurses who work in ICUs and nurses who manage drug therapy were able to participate in this survey. Nurses who did not manage drug therapy or who had less than one month of working experience in ICUs were not able to participate to this survey.

Data Collection

To collect data the authors used the instrument developed by an Italian research group^{7,8}. This instrument is named “Knowledge, Attitude and Behavior (KAB) in Medication Errors questionnaire”. The first section of this aims to explore the sociodemographic and professional characteristics of the sample. The Knowledge, Attitude and Behavior section aims to explore the nursing knowledge, attitudes and behavior about some strategies to prevent MEs, respectively. Participants were asked to express their degree of agreement with each item in the questionnaire, using a Likert scale.

KAB in Medication Errors questionnaire was translated in several languages and cross-cultural adapted to different countries such as Italy, Malta, Spain and Iran^{9,10}. All instrument versions confirm a good internal consistency measured with Cronbach's alpha. Indeed, the Persian version has a Cronbach's alpha value of .951; the Ital-

ian version has a Cronbach's alpha value of .776, the Spanish version has a Cronbach's alpha value of .849 and the English version has a Cronbach's alpha value of .790^{3,9,10}. In this international study, all sections of the instrument have good reliability. Indeed, knowledge section has a Cronbach's alpha value of .723; attitude section has a Cronbach's alpha value of .778 and behaviour section has a Cronbach's alpha value of .861.

Ethical Consideration

Before data collection, the Ethical Committee of each country included have authorized the study. All participants signed informed consent.

Statistical Analysis

The sample socio-demographic and professional characteristics were analyzed by descriptive statistics analysis, performed with SPSS[®] statistical software, version 25. To verify the distribution of each item, means, standard deviation (SD), skewness, and kurtosis were calculated. Shapiro-Wilk and Kolmogorov-Smirnov exploratory tests were also used. Following the analysis made by the author of the instrument³, three multiple logistic regression models were developed to identify the predictor variables of knowledge, attitudes, and behaviors, using the strategy proposed by Hosmer & Lemeshow¹⁴. For this purpose, three dichotomous variables were created ex-novo: 'adequate knowledge', 'positive attitudes' and 'correct behaviors', grouping all those who had responded with a medium-high degree of agreement ("very much agree" or "totally agree") to at least *n-1* items in the respective

sections^{3,7,8}. The odd ratio (OR) and its 95% confidence interval (95% CI) were calculated for each independent variable. The significance level was set at $p < .05$.

Results

Characteristics of the Sample

Table I shows the demographics and professional characteristics of the nursing sample. The international sample is made up of 1383 nurses: of these, 478 (34.6%) were men and 900 (65.1%) women. The mean age of the sample is 35.61±9.08 years with a range of 19-61.

Descriptive Statistics on Knowledge Scale Across Countries

Knowledge Scores

The knowledge section of the instrument aims to evaluate the degree of agreement of the participants regarding some strategies to prevent MEs in ICUs. If participants completely agreed on each item of this section, the total score achievable is 35.

Table II shows the mean degree of agreement across countries included. Specifically, Qatar comes out on top (mean degree of agreement: 31.1): participants totally agree on most of the proposed strategies of MEs prevention. At the same time, Ecuador appears to be the country with the lowest degree of agreement among participants (mean degree of agreement: 20.56).

Table I. Demographics and professional characteristics of the nursing sample.

Variable	N (%)
Gender (Male vs. Female)	478 (34.6)/900 (65.1)
Age (SD)	35.61 (9.08)
Country (Italy vs. Other countries)	616 (44.5)/767 (55.5)
Work experience in years (SD)	10.87 (8.41)
Education post-degree (Yes vs. No)	279 (33.49)/604 (66.51)
Education on drug preparation during university degree (Yes vs. No)	1266(91.50)/114 (8.20)
Education on drug preparation during post university degree course (Si vs. No)	810 (58.60)/318 (23.00)
Access to Internet connection on workplace (Yes vs. No)	1130 (81.70)/219 (15.80)
Access to library on workplace (Yes vs. No)	840 (60.70)/540 (39.00)
Knowledge of English language (insufficient vs excellent)	128 (9.30)/143 (10.3)
Hours per week to continuous education	
< 1hour per week	656 (47.4)
2-5 hours per week	472 (34.1)
6-10 hours per week	87 (6.3)
> 11 hours per week	55 (4.0)
Never	104 (7.5)

Table II. Means of degree of accordance with each item of knowledge, attitude and behaviour section related to each country included.

Country	Iran	Malta	Spain	Pakistan	Nepal	Qatar	Ecuador	Australia	Finland	Italy	Egypt	Jordan
Know_1	4.02	4.3	4.34	4.35	3.88	4.69	4.7	4.6	4.18	4.1	4.6	4.36
Know_2	4.05	3.89	4.06	4.02	3.7	4.43	3.84	3.48	4.11	3.62	4.24	3.88
Know_3	4.09	4.42	4.04	3.89	3.88	4.37	4.05	4.02	4	3.69	4.3	4.06
Know_4	4.09	4.3	-	4.27	3.88	4.69	-	4.24	4.11	3.81	4.43	4.22
Know_5	4.16	4.08	-	4.35	3.84	4.55	-	3.98	4.75	2.99	4.02	4.02
Know_6	4.09	3.87	4.16	3.81	3.7	3.98	3.74	3.74	3.89	3.53	4.02	3.66
Know_7	4.34	4.32	4.4	3.93	3.79	4.39	4.23	4.28	3.86	4.16	4.51	3.99
Total of mean score	28.84	29.18	21	28.62	26.67	31.1	20.56	28.34	28.9	25.9	30.12	28.19
Att_1	2.8	2.79	2.98	2.87	2.42	2.98	2.89	2.89	2.93	2.87	2.84	2.77
Att_2	2.77	2.75	2.98	2.82	2.65	2.94	2.98	2.91	2.68	2.85	2.84	2.74
Att_3	2.89	2.83	2.88	2.83	2.65	2.92	2.91	2.64	2.89	2.85	2.76	2.71
Att_4	2.82	2.75	2.92	2.77	2.56	2.88	2.91	2.96	2.89	2.87	2.61	2.74
Att_5	2.77	2.83	2.9	2.77	2.51	2.82	2.91	2.89	2.89	2.85	2.71	2.75
Att_6	2.8	2.87	2.73	2.83	2.58	3	2.91	2.89	2.75	2.85	2.8	2.8
Att_7	2.8	2.81	2.96	2.81	2.65	3	2.98	2.94	2.93	2.94	2.85	2.74
Total of mean score	19.65	19.63	20.35	19.7	18.02	20.54	20.49	20.12	19.96	20.08	19.41	19.25
Behav_1	4.23	4.66	4.6	4.74	4.35	4.92	4.93	4.55	5	4.64	4.84	4.64
Behav_2	4.32	4.83	4.64	4.74	4.51	4.96	4.86	4.77	4.96	4.59	4.76	4.63
Behav_3	4.36	4.68	4.6	4.4	4.35	4.9	4.84	4.47	4.93	4.61	4.6	4.38
Behav_4	4.05	4.89	4.74	4.62	4.33	4.92	4.95	4.77	4.86	4.63	4.82	4.59
Behav_5	4.45	4.62	4.56	4.61	4.26	4.92	4.86	4.81	3.92	4.49	4.7	4.46
Total of mean score	21.41	23.68	23.14	23.11	21.8	24.62	24.44	23.37	23.67	22.96	23.72	22.7

Know_1: Drug dosage calculation reduces errors in the preparation phase;
 Know_2: Computerized prescribing and dispensing reduces the risk of error;
 Know_3: Individualized delivery system reduces risk of error;
 Know_4: Medication administration protocols, posters, and informational brochures reduce the risk of error;
 Know_5: Pharmacist assistance during the medication preparation phase reduces the risk of error;
 Know_6: Noise and alarms increase the risk of error;
 Know_7: Excessive workload increases the risk of error.

Att_1: Ongoing and specific training reduces the risk of error;
 Att_2: Awareness in management reduces the risk of error;
 Att_3: Motivation can improve performance;
 Att_4: Guidelines improve management;
 Att_5: Protocols, guidelines, and procedures affect behavior;
 Att_6: Competencies should be evaluated regularly;
 Att_7: Mistakes are an opportunity for improvement.

Behav_1: Hand washing;
 Behav_2: Checking vital signs;
 Behav_3: Speed of infusions;
 Behav_4: 8 G rule (right prescription, right drug, right patient, right dose, right route of administration, right time, right recording, right control);
 Behav_5: Double check

Focusing on the mean obtained for each item, it is possible to observe a medium-high degree of agreement in each of the countries included.

Attitude Scores

The attitudes section of the instrument aims to assess the degree to which participants agree with some strategies that leverage both personal and professional attitudes to deliver safe, quality care practice. If participants completely agreed with each item, the total score achievable is 21.

Table II shows the mean degree of agreement in the different countries included. Specifically, Qatar once again leads the way (mean degree of agreement: 20.54): participants agree on most of the items proposed. At the same time, Nepal was the country with the lowest level of agreement among participants (mean degree of agreement: 18.02). Focusing on the means obtained for each item, it is possible to observe a medium-high degree of agreement in each of the countries considered.

Behavior Scores

The behaviors section of the instrument aims to assess the degree of agreement of participants regarding some behaviors for the prevention of ME. If the participants completely agreed on each item, the total score achievable is 25.

Table II shows the mean degree of agreement in the countries included. Specifically, Qatar is once again the leader (mean degree of agreement: 24.62): the participants totally agree on most of the items proposed. At the same time, Iran was the country with the lowest level of agreement among the participants (mean degree of agreement: 21.41). Focusing on the averages obtained for each item, it is possible to observe a medium-high degree of agreement in each of the countries included.

International Comparison Between Countries

Knowledge Scores

Nurses who have a university degree present an “adequate knowledge” more frequently than nurses who have a non-university degree (OR: .569, 95% CI: .429-754, $p < .001$). In addition, adequate knowledge appeared to be more prevalent in the younger and/or in nurses who have low work experience (OR: .981, 95% CI: .967 - .996, $p < .05$ OR: .973, 95% CI: .958-989, $p < .05$, respectively) (Table III).

Attitude Scores

Women show positive attitudes more frequently than men (OR: 1.747, 95% CI: 1.237 - 2.468, $p < .05$). Post-basic training also plays a key role in the development of positive attitudes (OR: 1.799, 95% CI: 1.201-2.695, $p < .05$), as does having addressed the topic during basic training (OR: 1.890, 95% CI: 1.127-3.168, $p < .05$) or having an Internet connection at work (OR: 2.23, 95% CI: 1.497-3.325, $p < .001$) or library access (OR: 1.587, 95% CI: 1.126-2.238, $p < .05$) (Table III).

Behavior Scores

Women showed correct behaviors more frequently than men (OR: 2.243, 95% CI: 1.310-3.839, $p < .05$), as do those who have attended post-basic training courses (OR: 2.671, 95% CI: 1.326-5.382, $p < .05$) (Table III).

Knowledge, Attitude and Behaviour Scores

In the first instance, a model was evaluated to predict adequate or inadequate knowledge by the attitude scores. Descriptive statistics show that approximately 92.3% of nurses who have an ‘adequate knowledge’ have also ‘positive attitudes’ toward medication management. This pattern is statistically significant, $\chi^2 = 47.282$, $p < .001$, $gl=1$. Analyzing the OR and confidence intervals, it is possible to assume the predictive role of attitudes towards knowledge: that is, positive attitudes statistically significantly improve the level of knowledge (OR: 3.746, 95% CI: 2.607-5.384, $p < .001$).

Particularly interesting are also the results for the model that tests the role of knowledge and attitudes as predictors of behavior. In this case, the χ^2 statistic reveals significance ($\chi^2 = 78.419$, $p < .01$, $gl=1$; $\chi^2 = 30.212$, $p < .01$, $gl=1$, respectively). Findings show that adequate knowledge improves behaviors in a statistically significant manner, and at the same time, positive attitudes predict correct behaviors by nurses.

Discussion

This study aimed to explore the degree of agreement among international nurses regarding some strategies of error prevention. Literature divides the etiological factors of ME into variables related to the personal and professional characteristics of the healthcare professional, and variables related to the organization of the medication management process¹⁵⁻¹⁷. Based on this consideration,

Table III. Predictive variable to knowledge, attitude and behavior scores.

Independent variable	Knowledge scores			Attitude scores			Behavior scores		
	OR (95% IC)	B	p	OR (95% IC)	B	p	OR (95% IC)	B	p
Sex (male vs female)	1.104 (.836-1.459)	-.099	.486	1.747 (1.237-2.468)	.558	.002	2.243 (1.310-3.839)	.808	.003
Title of study (Universit. vs. Non-uni)	.569 (.429-754)	-.564	< .001	1.140 (.775-1.678)	.131	.506	.873 (.492-1.548)	-1.36	.642
Education post-base (No vs. Yes)	1.302 (.894-1.897)	.264	.169	1.799 (1.201-2.695)	.587	.004	2.671 (1.326-5.382)	.983	.006
Medication errors argument in university courses (No vs. yes)	.787 (.466-1.330)	-.239	.371	1.890 (1.127-3.168)	.636	.016	1.122 (.438-2.874)	.115	.810
Medication errors argument in post university courses (No vs Yes)	1.125 (.806-1.571)	.118	.488	1.120 (.747-1.680)	.114	.583	1.061 (.548-2.055)	.059	.861
Access to Internet connection (No vs. Yes)	.682 (.458-1.016)	-.382	.060	2.231 (1.497-3.325)	.802	< .001	1.118 (.555-2.252)	.112	.754
Access to library (No vs Yes)	.957 (.727-1.261)	-.044	.756	1.587 (1.126-2.238)	.462	.008	1.568 (.918-2.678)	.450	.100
Age (continuos variable)	.981 (.967-.996)	-.019	.012	1.011 (.991-1.031)	.011	.284	1.019 (.998-1.051)	.019	.239
Work experience (continuos variable)	.973 (.958-.989)	-.027	.001	1.003 (.982-1.024)	.003	.784	1.015 (.981-1.050)	.015	.395

we intercepted healthcare workers involved in medication, focusing on the role of nurse. Indeed, literature gives to nurses the greatest responsibility for MEs¹⁸⁻²³.

This study explored nursing knowledge, attitudes, and behavior on MEs prevention through an international, observational, cross-sectional study. The results of this study show a strong relationship between positive staff attitudes and correct behaviors and/or adequate knowledge, as well as between adequate knowledge and correct behaviors. These empirical observations agree with the findings of Di Muzio et al³ in an Italian multicenter study.

Descriptive statistics made on the international sample show a medium to the high degree of agreement among participants regard to some strategies to prevent ME. Specifically, the study shows a degree of adequate knowledge more frequently in the younger or less work-experienced nursing population compared to an older or more work-experienced nursing population. These findings agree with findings of the study conducted by Sneek et al²⁴ in which levels of theoretical knowledge and medication skills among nurses are assessed. Statistical analyses show that younger nurses obtain higher knowledge scores than older colleagues. The present study analyzed adherence by nurses regarding some behaviors of MEs prevention. Statistically significant differences in the implementation of correct behaviors were found between men and women, to the advantage of the latter, and between those with a university or non-university education, to the advantage of the former. Literature is extensive in this field^{25,26}. Irajpour et al²⁷, their quasi-experimental study, show how interdisciplinary training can reduce and prevent ME in the ICU setting.

Although this study represents the first international comparative study on the prevention of MEs, it is not without limitations. First, no cause-and-effect relationship can be deduced from the results. Moreover, the study sample was collected using the methodology of convenience sampling, establishing precise and uniform selection criteria in each enrolled center. Also, Italy was predominant in terms of the study sample. The administration of the questionnaire took place through the use of a Google Form, which reaches, as already noted, a wider reference population, but does not allow access to data on non-response and adherence to the study. In addition, since this is a self-report scale, it is necessary to weigh

the reliability of responses. Several studies have highlighted the main limitations of this type of scale, such as distraction in the compilation of items and/or social desirability²⁸.

Conclusions

Findings of this study show a medium to high degree of agreement among participants concerning some preventive strategies of ME. In addition, the results of the present study show a strong relationship between positive nurses' attitudes and correct behaviors and/or adequate knowledge, as well as between adequate knowledge and correct behaviors.

Further studies are needed to investigate the issue of ME in relation to the cultural background of nurses, as well as to assess consonances and dissonances among international nurses. The production of international guidelines that can help to prevent ME in every setting and every country would be desirable.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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