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Validation of a questionnaire for ICU nurses to assess knowledge, attitudes and behaviours towards medication errors

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Key words: Medication errors, survey, ICU nurses', Cronbach's alpha, validation
Parole chiave: Errori terapeutici, indagine, infermieri di terapia intensiva, alpha di Cronbach, validazione

Abstract

Aim. *Medication errors are dangerous for the patients in an intensive care unit (ICU).*
Little is known about knowledge, attitudes and professional behaviour of nurses towards prevention of errors and clinical risk management can reduce errors during the preparation and administration phases of intravenous drugs.
In this study we have evaluated the reliability and validity of the questionnaire to examine knowledge, attitudes and professional behaviour of ICU nurses'.
Methods. *Reliability analysis was tested and content validity evaluated using Cronbach's alpha to check internal consistency with the intention to obtain no misunderstanding with the results.*
The questionnaire composed of seven sections for a total of 36 items, was administrated among ICU nurses working in a university hospital in Rome, Italy. Data were collected in October 2015. Statistical analysis was performed with the statistical software for Windows SPSS, version 22.0.
Results. *The questionnaire was administered to 30 ICU nurses' in anonymous, voluntary and self-administered form with close-ended type of questions, except for the socio-demographic characteristics.*
The highest value of Cronbach's alpha resulted on 19 items (alpha= 0,776) meaning that the questionnaire has a satisfactory internal validity.
The study highlights that nurses (80%) are aware that appropriate knowledge on the calculation of medication's dose is essential to reduce medication errors during the phase of drugs'preparation.
Conclusions. *This study demonstrated that a short version of the questionnaire has very good reliability properties in the study and this needs to be taken into account for future studies.*

Background

Medication Errors can be particularly common in the ICU (1).

Medication errors represent approximately 78% of medical errors in ICUs, and patients in ICU experience an average of 1.75 medication errors each day (2).

For medication error we mean any adverse, unwelcome, preventable event which can cause or lead to an inappropriate use of drugs or to a danger for the patient. Such an

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event can be caused by many factors, such as: a prescription's error, a wrong transmission of prescription, labelling, packing or de nomination, setting up, distribution, medication, education, monitoring, as well as a wrong use (www.nccmerp.org) (3). The literature reveals that medication errors in ICUs can occur as a result of patient clinical complexity (4), the number of administered drugs, the frequent change of prescriptions, the need to fix the drug dose depending on the patient's weight, the potential incompatibility between intravenous (IV) drugs as well as the prescription speed (5). The patients in an intensive care unit (ICU) will typically experience a mean of 1.7 errors per day (6).

Errors prevention in complex environments such as the ICU relies heavily on the presence of a safety culture (7).

Many authors show that medication errors can occur throughout the process of medication management and the whole management system of the drugs (8) must therefore be taken into account for the purpose of prevention, according to the literature, the administration phase represents the moment the most crucial of the process (9).

Errors caused from multiple administrations can be particulary common in ICUs (10). Critical patients receive almost twice as many drugs in comparison to hospital patients staying in other operating units (11, 12).

A research reported that of the 55767 medication errors occurring in ICUs, 44% were during administration, with omissions and wrong dosages being the most frequently occurring errors (13).

ICU wards are much more complex than other wards since more drugs are used and most of those drugs are administered intravenously (6).

According to literature four are the observed variables which can influence medication errors: knowledge, attitudes, behaviour and training needs. Literature states that inadeguate nurses' knowledge and training on the use of IV drugs, can be reported as a cause of error (14). Some authors agree that wrong professional behaviour can cause medication errors (15); the same is for professional attitudes which are considered from Leape as the best approach to identify errors (16).

The aim of this test retest study is to evaluate the reliability and validity of the questionnaire in ICU nurses' as a tool to assess knowledge, attitudes and behaviors towards medication errors.

Methods

Study population

The tool was subjected to validation to test items' internal feasibility, validity and reliability. It was retested on 30 ICU nurses, working in a university hospital in Rome, Italy.

Sampling and methods of data collection: self-administered questionnaire to ICU nurses.

The questionnaire is preceded by a brief description in which details and the aim of the study are explained, protecting anonimity of partecipants (informed consent).

Questionnaire

Items were generated on a review of the literature and through counseling with subject matter experts, including ICU nurses. Further modification of the items have been done after the results of the pilot study (17).

The first full version of the questionnaire was built ad hoc and was made of 43 items as well as seven sections.

A new version of the questionnaire comprehends three sections and includes 19 items.

The first section on knowledge on the use of IV drugs in ICUs, the second section investigates attitudes on the use of IV drugs in ICUs and the third and final section

includes behaviour on the use of IV drugs in ICUs.

All questions required one or more closed-ended questions. As far as knowledge and attitudes sections are concerned, seven questions were identified, while regarding the behaviour sections five questions were identified.

A five-level Likert scale (Strongly agree, Agree, somewhat agree, neither agree, strongly disagree) was used for knowledge and behaviour sections. Regarding the section attitudes, a three-level Likert scale (agree, uncertain, disagree) was used.

Statistical analysis

Data entered into a database using the program DB IV were processed with the statistical software SPSS ® software (Statistical Package for Social Science) for Windows, version 22.0.

Descriptive analyses were performed using frequencies, percentages, and frequency table for categorical variables.

Questionnaire's reliability was evaluated by calculating *Cronbach's alpha* (18), a measure of internal consistency, that is the ratio of the covariance sum of the scores of all items and the total variance of items themeselves. Such parameter can be interpreted as an average of the correlation coefficients calculated for each possible division of items into two groups of equal dimension. The assessment's reliability of a scale consists in the estimation of how much does the score variation can be real or actual, rather than being due to chance or casual errors. The reliability's degree estimated from *Cronbach's alpha* is expressed as a proportion: for example a 0,70 realibility's degree means that the measured variance can be considered 70% reliable (19).

Data were collected in October 2015.

Ethics

The approval of the Ethics Commitee for questionnaire's administration, with aknowledge of notification for the study, has been required.

Results

Validation of the questionnaire

The highest value of Cronbach's alpha for the three sections knowledge, attitudes and behaviour resulted on 19 items (alpha= 0,776). The addition of other items, one at a time, reduced the alpha value. When other items were added, for a total of 23 items, Cronbach's alpha decreased to 0,49, meaning that the full version of the questionnaire has an unsatisfactory internal validity (17).

Reliability analysis, the correlation of the correct total item and the variability of *Cronbach's alpha* if an item is excluded, is shown in the Tables 2A (Knowledge), 2B (Attitudes), 2C (Behaviour).

Section 1:

The higher value of Cronbach's alpha resulted achieved on seven items of the knowledge (alpha=0,716).

Section 2:

The internal reliability for the seven items in the attitudes section has an acceptable minimun level of reliability (alpha=0,701).

Section 3:

The higher value of Cronbach's alpha resulted achieved on five items of the behaviour (alpha=0,707).

The minimum acceptable level for the comparison between groups of individuals does not require a high coefficient: values between 0.50 and 0.70 are considered acceptable (19).

Sociodemographic characteristics of the sample

The sample consisted of 30 nurses' ICU.

The average age of the sample is 30.7 years (±4,2) with 33.3% of males and 66.7 % of females. A total of 80.0% of the sample

has a University degree in Nursing, while the remaining 20.0% do not have a University degree. Only 16.3 % of nurses has a first level Master (Table1).

Knowledge

All the sample claimed to have studied topics related to IV drug's preparation and administration during basic studies.

Concerning knowledge on the use of IV drugs 80% of nurses considered knowledge on drug dosage calculation essential in order to reduce medication errors during the phase of drug preparation, 83,3% recognize computerized provider order and administration reduce errors during the preparation phase. 63,3% of the sample belives that dispensation in a package ready to be administered, directly prepared in the pharmacy, or rather individualized supply system of drug, allows to reduce the percentage of medication errors; 80% of nurses in ICUs stated that the use of protocols, posters, as well as information brochures concerning IV drugs administration within the wards, could be useful in order to reduce medication errors.

A relevant aspect related to knowledge, concerns sounds alarms and ward emergencies, which can cause distractions both in preparation and administration phases of IV drugs. The majority of the sample (96,7%) of nurses admitted that distractions during the preparation and administration phases of IV drugs, can lead to medication errors.

Attitudes

Positive attitudes can reduce errors during the preparation and administration's phases of drugs.

According to about 83% of the sample, in order to reduce errors is necessary to take preventive measures, such as frequent trainings, authoritative guidelines which should be drawn up considering the available scientific evidence, continuous evaluation of clinical ills, as well as the error report, in order to improve care.

Professional behaviour

Correct behaviour is associated with adeguate knowledge to prevent medication errors.

For 83% of the sample basic behaviour as far as asepsis (hand washing) is concerned is adopted, before the preparation of therapy.

An important aspect shared by more than 80% of the sample, covers professional behaviour on the rate of infusion of IV drugs, as well as the monitoring of vital signs before and after medication's administration. Only 66,7% of the sample perform a double check to verify the correct correspondence between prescription, preparation and administration of IV drugs, before administration.

A total of 80% of our sample knows that respect the correct infusion rate of solutions for IV administration (such as chemotherapy, antibiotics, amines, heparin, etc.) reduces complications.

Some authors underline that it is essential that ICU nurses demonstrate competency in calculating medication infusion rates. Depending on the medication, it will be necessary for nurses to calculate and document the concentration of the medication in the I.V. solution once prepared (20).

Discussion

Medication errors represent the most common error class which can occur in hospitals (21).

The act of medication administration represents 40% of nurses' clinical care activities (22).

Most of drugs involve some calculus for bolus administration or continuous infusion administration. Nowadays reliable data related to medication errors in adults hospitalized in ICUs, are not yet available.

Table 1 - Demographics and professional and personal characteristics of the responding nurses

Variables	n	(%)
Total	30	100
Age, years (30)[a]		
<30	15	(50.0)
31-40	15	(50.0)
Gender (30)[a]		
Male	10	(30.1)
Female	20	(69.9)
Educational qualification (30)[a]		
Degree	24	(80.0)
No Degree	6	(20.0)
Postgraduate training courses (30)[a]		
Master	20	(16.3)
Other university courses	16	(13.1)
Years of Work (30)[a]		
<1	1	(3.3)
1-5	14	(46.6)
6-10	9	(30.0)
>10	6	(20.0)
Topics related to the preparation and administration of IV drugs treated during the basic course (30)[a]		
No	0	(0)
Yes	30	(100.0)
Topics related to the preparation and administration of IV drugs treated during the post-basic course (22)[a]		
No	8	(36.6)
Yes	14	(63.3)
English language knowledge (30)[a]		
Verylow	2	(6.7)
Low	6	(20.0)
Intermediate	10	(33.3)
Good	12	(40.0)
Excellent	0	(0)
Internet available in the workplace (30)[a]		
No	0	(0)
Yes	30	(100.0)
Library (also on-line) available in the workplace (29)[a]		
No	11	(37.9)
Yes	18	(62.1)
Hours per week dedicated to continuing medical education (30)[a]		
<1	15	(50.0)
1–5	15	(50.0)
6–10	0	(0)
>10	0	(0)

[a]Number of nurses responding to the question.

Table 2A - Item-Total Statistics - Item-total correlation and variability of Cronbrach's alpha, if one item was deleted

Item knowledge	Scale mean if item deleted	Scale variance if item deleted	Corrected tem-total correlation	Cronbach's Alpha if item deleted
The calculation of IV drugs's doses during the preparation phase can reduce errors.	15,23	22,737	,099	,741
Computer provider order entry CPOE (entry system of computerized prescription) and computer administration can reduce errors during the preparation's phase	15,87	20,809	,240	,723
The dispensation in a package ready to be administered, directly prepared in the pharmacy, or rather individualized supply system of drug, allows to reduce the percentage of medication errors	15,87	17,913	,359	,706
Protocols, posters and brochures related to IV administration in the wards, help to reduce errors	16,33	16,575	,684	,617
The presence of a pharmacist during the preparation's phase of IV drugs does not reduce the risk of errors	16,37	15,206	,722	,595
Sounds alarms and ward emergencies can cause distraction both in the preparation and administration's phases of IV drugs	15,27	19,789	,532	,672
Workloads (shift changes, double shift, overtime, etc...) can contribute to IV medication errors	16,27	16,892	,424	,689

Table 2B - Item-Total Statistics - Item-total correlation and variability of Cronbrach'salpha,if one item was deleted

Item attitudes	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Ongoing and specific training on safe menagement of IV drugs could reduce the risk of error	10,80	2,993	,401	,671
Awareness for the prevention of error and clinical risk management could reduce the error during the preparation and administration's phases of drugs	10,87	2,809	,718	,597
The worker's motivation can improve professional performance during the whole medication process	10,80	3,338	,393	,676
For secure menagement of the entire menaging process of IV drugs, some authoritative guidelines drawn up taking into account the available scientific evidence are necessary	10,83	2,695	,691	,593
Protocols/ guidelines/ procedures can affect professional behaviour, ensuring proper menagement of theraupetic process	10,90	2,714	,490	,645
Clinical skills about safe menagement of drug therapy should be regularly evaluated	10,97	3,275	,150	,752
Medication errors should be reported in order to become an opportunity for improving care	10,83	3,523	,202	,712

Table 2C - Item-Total Statistics - Item-total correlation and variability of Cronbrach's alpha, if one item was deleted

Item behaviors	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
Before the preparation and administration of therapy is must be washed hands.	10,33	8,782	,608	,595
Before and after administration of vasoactive drugs (dopamine, dobutamine, nitroglycerine, etc) check vital signs.	10,13	8,602	,781	,532
Respect the rate of infusion of solutions for IV administration (such as chemotherapy, antibiotics, amines, heparin, etc..) reduces complications	10,13	8,878	,688	,568
Follow the rule of six R (right prescription, right drug, right patient, right dose, right route of administration, etc) reduces errors.	9,53	12,947	,095	,770
Perform a double check to verify the correct corrispondence between prescription, preparation and administration of IV drugs, before administration	10,40	9,697	,280	,764

According with the scientific literature, the study highlights that nurses (80%) are aware that appropriate knowledge on the calculation of medication's dose is essential to reduce medication errors during the phase of drugs' preparation.

Duffield CM, et al. state that nurses workloads (shift changes, double shift, overtime, etc) and some environmental factors can contribute to IV medication errors (23). This is also confirmed by our study, that shows 96,7% of nurses consider some environmental factors affecting the risk of error, such as: loud noises, poor lighting and untidy working areas (24).

To prevent medication errors, our findings support the need for qualified and trained ICU nurses (6). 93% of our sample stated that the presence of protocols/ guidelines/ procedures in ICU can affect professional behaviour, ensuring proper management of theraupetic process.

An encouraging data concerns the percentage of nurses (93,7%) who find it very important to improve their knowledge on the preparation and administration of IV drugs.

Conclusions

Preparation and administration IV drugs are priority responsibility of a nurse in ICUs. Are two important moments to intercept errors occurred in earlier phases of drug management, before they reach the patient.

This study demonstrates that the short version of the questionnaire as a tool to examine knowledge, attitudes and behaviours towards medication errors has very good reliability properties and in terms of internal consistency and validity appeared to have a good performance and this needs to be taken into account in future studies.

The limits of this study were that it was conducted in a single place and the small sample size, but the main objective was the validation of the questionnaire. The reliability of answers could be affected by the nature of the study (cross-sectional). However, the questionnaire have demonstrated an high internal consistency.

This research is only the starting point of an Italian multi-center study which aims to stress the predictors of medication errors in ICUs.

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Riassunto

Validazione di un questionario per gli infermieri di terapia intensiva per valutare le conoscenze, le attitudini e comportamenti verso gli errori terapeutici

Scopo. Gli errori terapeutici sono pericolosi per i pazienti in un reparto di terapia intensiva (ICU). Poco si conosce riguardo le conoscenze, gli atteggiamenti e i comportamenti degli infermieri verso la prevenzione degli errori e gestione del rischio clinico come strategia per ridurre gli errori durante le fasi di preparazione e somministrazione dei farmaci per via endovenosa.

In questo studio abbiamo valutato l'affidabilità e la validità del questionario per esaminare le conoscenze, gli atteggiamenti e i comportamenti degli infermieri che lavorano nelle terapie intensive/rianimazioni.

Metodi. È stata valutata l'affidabilità del questionario, calcolando l'alfa di Cronbach, ovvero il rapporto tra la somma della covarianza dei punteggi di tutti gli items e la varianza totale degli items stessi (consistenza interna delle risposte). Il questionario composto da sette sezioni per un totale di 36 domande, è stato somministrato agli infermieri di una terapia intensiva che lavorano in un ospedale universitario a Roma, Italia. I dati sono stati raccolti nel mese di ottobre 2015. L'analisi statistica è stata effettuata con il software statistico SPSS per Windows, versione 22.0.

Risultati. Il questionario è stato somministrato a 30 infermieri di terapia intensiva in forma anonima, volontaria e auto-somministrato con domande chiuse, tranne che per le caratteristiche socio-demografiche. Il valore di alfa di Cronbach risulatato dalle 19 domande (alfa = 0776) dimostra che il questionario ha una validità interna soddisfacente. Lo studio mette in evidenza che gli infermieri (80%) sono consapevoli del fatto che possedere conoscenze adeguate sul calcolo del dosaggio dei farmaci è essenziale per ridurre gli errori di terapeutici durante la fase di preparazione dei farmaci.

Conclusioni. Lo studio ha dimostrato che una versione breve del questionario ha ottime proprietà di affidabilità e per tale motivo dovrebbe essere preso in considerazione per la conduzione di studi simili futuri.

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