Knowledge, attitudes, behaviour and training needs of ICU nurses on medication errors in the use of IV drugs: a pilot study

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Abstract

Background. Prior studies have shown that lack of knowledge and training, incorrect behaviours and attitudes put Intensive care unit (ICU) patients at risk. The aim of this study was to assess knowledge, attitudes and professional behaviour of Italian nurses towards preparation and administration of intravenous medications in ICUs. Reliability and validity of the questionnaire were assessed as well.

Methods. A survey was conducted on a sample of Italian nurses in 2015 through a self-administered questionnaire. Reliability was tested and content validity was evaluated using Cronbach's alpha. Multiple logistic regression models were built to identify predictors of knowledge, attitudes and behaviours.

Results. In total, 123 nurses completed the questionnaire. For the variable 'adequate knowledge' nurses were divided in those who had correctly answered 7 of 8 questions on knowledge and everyone else, while for 'attitudes and professional behaviour' responders were grouped into those who showed a positive attitude and appropriate behaviour and everyone else. Results of the multiple logistic regression analyses show some association, although not statistically significant, between correct behaviour, positive attitudes and the years of work experience. It is interesting to note that appropriate knowledge weighs negatively on correct behaviour (OR 0.06, 95% CI 0.04-0.42). Moreover, graduate nurses have more appropriate knowledge than those who are not. A high level of interest for specific training was reported by almost all responders. Cronbach's alpha for all three sections together resulted in a value of 0.49.

Conclusions.This pilot study demonstrated the need to amend the questionnaire, especially the knowledge and behaviour sections, in which the Cronbach's alpha was less than 0.7. Targeted educational programs are needed to improve the expertise of nurses to reduce medication errors during preparation and administration of IV medications in the ICU.

Key words: medication errors, attitudes, knowledge, professional behavior, ICU nurses, cross-sectional survey, Cronbach's alpha, validation

Introduction

Medication errors in intensive care units (ICUs) can risk patients' health or cause their death. (1) A narrative literature review estimates medication errors' percentage is included among 12% and 20% of total errors. (2) Such errors are expensive from a human, economic, as well as social point of view. (3) Under ˝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 event can be caused by many factors, such as: a prescription error, a wrong transmission of a prescription, labelling, packing or denomination, setting up, distribution, medication, education, monitoring, as well as inappropriate use (www.nccmerp.org). (4) Such errors have human, economic and social consequences. (5) According to many studies, medication errors in ICUs can occur as a result of patient clinical complexity, (6) 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. (7) Rothschild JM et al. claim that medication errors represent 78% of clinical errors in ICUs, and patients every day experience 1.75 errors on average during their stay in ICU. About 20% of medication errors put the patient's life in danger, while 40% require some treatment. (8) Although errors can occur at any time in the medication management process, and therefore the whole medication management system (9) must be taken into consideration, for the purpose of prevention, according to the literature, the administration phase represents the most crucial moment of the process. (10) The act of medication administration represents 40% of nurses'clinical care activities. (11) Errors caused from multiple administrations are particulary common in ICUs. (12) Critical patients receive almost twice as many drugs in comparison to hospital patients staying in other operating units. (13,14) Most drugs involve some calculation of bolus administration or continuous infusion administration. Nowadays, reliable data related to medication errors in adults hospitalised in ICUs, are not yet available.

Patient safety is an issue in all advanced health systems. Such concern is highlighted and shared by the World health organization (WHO) as well, which, since 2001, asks for urgent action by health organizations themselves (Ministry of Health, 2012). (5) Adverse events are far more numerous than those supposed or than those which actually damage the patient. Such events inevitably lead to poor quality care, in terms of effectiveness (clinical appearance), in terms of increased costs incurred

by the healthcare facility (organizational management aspect) and finally in terms of lost of patients' trust towards the hospital (loss of image).

According to the literature, there are four observed variables that can influence medication errors: knowledge, attitudes, behaviour and training needs. The literature states that inadequate nurses' knowledge and training on the use of IV drugs, can be reported as a cause of error. (15) Some authors agree that wrong professional behaviour (such as incorrect handwashing) can cause medication errors; (3) the same applies to professional attitudes, which are considered by Leape as the best approach to identifying errors. (16)

There are few studies that connect nurses' knowledge, attitudes, behaviour and training needs to the administration errors of IV drugs.

Based on our literature review, there are no tools to assess whether nurses' knowledge, attitudes, behaviour and training needs about the use of IV drugs in ICUs determine any medication errors.

The aim of this study was to describe ICU nurses' knowledge, attitudes, behaviour and training needs on the use of IV drugs in ICUs to prevent errors.

Methods

The survey is an empirical research method in which a questionnaire (self-administered in this case) is used for data gathering and statistical methods.

Such a survey is a useful tool for acquiring information.

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

It is a cross-sectional study.

The questionnaire consisted of 43 items as well as seven sections. It was

built *ad hoc* on the basis of the bibliographical research, followed by a systematic literature review relevant to the research question. Questions were intended to identify demographic factors (section A), professional features (section B), continuing professional development (section C), knowledge on the use of IV drugs in ICUs (section D), attitudes on the use of IV drugs in ICUs (section E), behaviour on the use of IV drugs in ICUs (section F), as well as training needs on the use of IV drugs in ICUs (section G). As far as knowledge and behaviour sections are concerned, 8 questions were identified, while seven questions were identified in the attitudes' section.

A three-level Likert scale (agree, uncertain, disagree) was used for the knowledge and attitudes' sections (tables 2,3). Regarding the behaviour section (table 4), a four-level Likert scale (always, often, sometimes, never) was used. In the last set of questions, (G), including the section on training needs on the use of IV drugs in ICUs, the respondent nurses were asked to express their opinion about their level of knowledge on the preparation and administration of IV drugs. They had to choose among four answers (very low, intermediate, good, excellent); nurses were also asked whether, according to them, improving their knowledge with training courses would be worthwhile (the answers were "yes" or "no").

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

The tool was subjected to validation to test the items'internal feasibility, validity and reliability. It was tested on 123 ICU nurses, working in two university hospitals in Rome. The questionnaire's reliability was evaluated by calculating *Cronbach's alpha*, (17) 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 themselves. Such a 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 of a scale's reliability consists of estimating how much the score variation is 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 degree means that the measured variance can be considered 70% reliable. (18) The scale's length (number of items) as well as the *inter-item* correlation (correlation between individual items) are factors that are able to modify a scale's reliability. Correlations between scales, also known as *inter-scale* homogeneity values, above their reliability index, indicate that two scales were constructed to measure the same concept; on the other hand, inter-scale homogeneity values below their reliability index mean that separate phenomena are measured. In this way we can determine whether the scale was able to measure that for which it was built and if the results are interpretable. (19) Finally, the Bartlett's sphericity test was performed to evaluate if a principal component analysis could be performed on the dataset.

Preliminary statistical analysis

A descriptive analysis of all the questionnaire's variables was performed using absolute and percentage frequencies (tables 1, 2, 3, 4). Three models of multiple logistic regression were later constructed to identify knowledge, attitudes and behaviour predictors (table 5). For this purpose the dichotomous variable called "appropriate knowledge" was created, grouping all those who correctly answered 7 of 8 questions on knowledge into one group and everyone else in the other (Model 1). For the same purpose, the dichotomous variables "positive attitudes" and "right behaviour" were created, respectively grouping those who correctly answered all the questions about behaviour into one group and everyone else into the other (Models 2,3). The following independent variables were tested in models: age (continuous), gender, years of work, year of graduation from basic study, degree type. The "appropriate knowledge" variable was also tested as a covariate both in the attitudes' model and behaviour model. In the latter, the "positive attitudes" variable was also tested.

Multiple logistic regression models were constructed using the strategy

suggested by Hosmer and Lemeshow (20) including the following phases: (a) univariate analysis of each variable; (b) Odds ratio (OR) and its related 95% Confidence Interval (CI).

For statistical analysis the SPSS ® software (Statistical Package for Social Science) for Windows, version 22.0 was used.

Ethics

The approval of the Ethics Commitee for questionnaire administration was received – Prot. 44/14 PT_ComEt CBM.

Results

Study population

The average age of the sample was 37.6 years (±9.2), with 30.1% of males and 69.9% of females. A total of 51.2% of the sample had a university degree in nursing, while the remaining 48.8% did not have a university degree. Only 16% of nurses had a first level Master's degree (table 1).

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

VARIABLES	n	(%)
Total	123	100
Age, years (123)[a]		
<30	33	(26.8)
31-40	42	(34.1)
41-50	37	(30.1)
51-60	11	(9.0)

Gender (123)[a]

Male	37	(30.1)
Female	86	(69.9)

Educational qualification (123)[a]

Degree	82	(66.6)
No Degree	41	(33.3)

Postgraduate training courses (50)[a]

Master	20	(16.3)
Ph. D	3	(2.4)
Specialization	3	(2.4)
Specialization Courses	8	(6.5)
Other	16	(13.1)

Years of Work Experience (123)[a]

<1	6	(4.9)
1-5	29	(23.6)
6-10	28	(22.8)
>10	60	(48.8)

Topics related to the preparation and administration of IV drugs covered during the basic course (123)[a]

No	4	(3.3)
Yes	119	(96.7)

Topics related to the preparation and administration of IV drugs covered during the

post-basic course (84)[a]

No	26 (21.1)
Yes	58 (47.2)

English language knowledge (123)[a]

Very low	20 (16.3)
Low	38 (30.9)
Intermediate	37 (30.1)
Good	21 (17.1)
Excellent	7 (5.7)

Internet available in the workplace (123)[a]

No	2 (1.6)
Yes	121 (98.4)

Library (also on-line) available in the workplace (120)[a]

No	31 (25.2)
Yes	89 (72.4)

Hours per week dedicated to continuing medical education (120)[a]

<1	66 (53.7)
1−5	43 (35.0)
6−10	7 (5.7)
>10	4 (3.3)

[a]Number of nurses responding to the question.

A total of 58.5% of the sample claimed to have studied topics related to IV drug preparation and administration during basic studies. In particular, the most common topics were: therapeutic indications, dilutions, interactions, contraindications, drug dosages' calculation, administration techniques.

A significant fact seems to be the time spent retraining; 53.7% of the sample stated spending less than one hour per week retraining.

Knowledge

The majority of the sample (88.6%) considered knowledge on drug dosage calculation essential in order to reduce medication errors during the phase of drug preparation (table 2).

A total of 84.6% of the sample stated that the use of protocols, posters, as well as information brochures concerning IV drug administration on the wards, would be useful in order to reduce medication errors.

Almost all of the nurses (87%) agreed that shifts changes (double shifts, overtime, etc.) as well as workload, contribute to IV medication errors.

A relevant aspect, related to knowledge, concerns alarms and ward emergencies, which can cause distractions both in preparation and administration phases of IV drugs. For 64.2% of nurses distractions during the preparation and administration phases of IV drugs, can lead to medication errors. A total of 78.7% of the sample considered the use of a single therapy chart as a good strategy for avoiding errors during the management process of IV drugs.

According to multivariate analysis there were no statistically significant associations; the strongest associations for appropriate knowledge are related to having a university degree.

Table 2. Knowledge on the use of IV drugs of the responding nurses in ICUs.

ITEM	Agree	Uncertain	Disagree
KNOWLEDGE	**n (%)**	**n (%)**	**n (%)**
The calculation of IV drug doses during the preparation phase can reduce errors (123)[a]	109 (88.6)	12 (9.6)	2 (1.8)
Computerized provider order entry system(CPOE) does not reduce errors during the preparation phase (122)[a]	62 (50.8)	44 (36.1)	16 (13.1)
Dispensation in a package ready to be administered, directly prepared in the pharmacy, or an individualized supply system of drugs, can reduce the percentage of medication errors (123)[a]	85 (69.1)	28 (22.8)	10 (8.1)
Procedures, posters and brochures related to IV administration on the wards, helps to reduce errors (123)[a]	104 (84.6)	15 (12.2)	4 (3.3)
The presence of a pharmacist during the preparation phase of IV drugs does not reduce the risk of errors (122)[a]	58 (47.5)	47 (38.5)	17 (14.0)
The use of a single therapy chart prevents errors during the management process of IV drugs (122)[a]	96 (78.7)	17 (14.0)	9 (7.3)
Alarms and ward emergencies can cause distractions both in the preparation and administration phases of IV drugs (123)[a]	79 (64.2)	19 (15.4)	25 (20.3)
Shift changes (double shift, overtime, etc.) as well as workloads can contribute to IV medication errors (123)[a]	107 (87.0)	11 (8.9)	5 (4.1)

[a]Number of nurses responding to the question. IV, intravenous.

Attitudes

Nurses'answers in the attitude section are encouraging (table 3). According to about 90% of the sample, in order to reduce errors it is necessary to take preventive measures, such as frequent trainings, authoritative guidelines which should be drawn up taking into consideration the available scientific evidence, continuous evaluation of clinical skills, as well as the error report, in order to improve care.

Almost all the nurses (90.2%) believe that awareness of prevention of errors and clinical risk management can reduce errors during the preparation and administration phases of drugs.

Multivariate analysis shows a statistically significant association between positive attitudes and feminine gender; on the contrary, appropriate knowledge is not associated with positive attitudes, even if an OR>1 was found.

Table 3. Attitudes on the use of intravenous (IV) drugs of the responding nurses in Intensive care units (ICUs).

ITEM ATTITUDES	Agree n (%)	Uncertain n (%)	Disagree n (%)
Ongoing and specific training on safe management of IV drugs could reduce the risk of error(123)[a]	113 (91.9)	8 (6.5)	2 (1.6)
Awareness of the prevention of error and clinical risk management could reduce errors during the preparation and administration phases of drugs (123)[a]	111 (90.2)	11 (8.9)	1 (0.8)
Worker's motivation can improve professional performance during the whole medication process (122)[a]	107 (87.7)	12 (9.8)	3 (2.5)

For safe management of the entire managing process of IV drugs, some authoritative guidelines drawn up taking into account the available scientific evidence are necessary (123)[a]	114 (92,7)	8 (6.5)	1 (0.8)
Protocols/ guidelines/ procedures can affect professional behaviour, ensuring proper management of theraupeutic processes (123)[a]	107 (87.0)	12 (9.8)	4 (3.3)
Clinical skills about safe management of drug therapy should be regularly evaluated (123)[a]	112 (91.1)	9 (7.3)	2 (1.6)
Medication errors should be reported in order to provide an opportunity for improving care (122)[a]	112 (91.8)	10 (8.2)	0

[a]Number of nurses responding to the question.

Professional behaviour

For almost all the sample, basic behaviour in regard to asepsis (hand washing) have been adopted, before the preparation of therapy (table 4).

Regarding the preparation of therapy in a dedicated room, contrasting answers with the literature come to light; in fact, only 38.2% of the sample prepares IV therapy in a specific room, whereas 33% directly prepare therapy at the bedside, probably due to the absence of such rooms.

An important aspect shared by more than 90% 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 administration.

Multivariate analysis results show some association, although not significant from a statistical point of view between correct behaviour, positive attitudes and increasing working experience. On the other hand

it is interesting to highlight that appropriate knowledge weighs negatively on correct behavior (OR 0.06; 95% CI 0.04-0.42).

Table 4. Behaviour on the use of IV drugs of the responding nurses in Intensive care units (ICUs).

ITEM BEHAVIOURS	Always n (%)	Often n (%)	Sometimes n (%)	Never n (%)
Do you wash your hands before preparing therapy? (123)[a]	98 (79.7)	24 (19.5)	1 (0.8)	0
Do you prepare therapy in a dedicated room? (123)[a]	47 (38.2)	29 (23.6)	14 (11.4)	33 (26.8)
Do you use personal protective equipement (gloves, mask, goggles, etc...) during the preparation and administration of IV drugs? (123)[a]	43 (35.0)	33 (26.8)	38 (30.9)	9 (7.3)
Do you check vital signs before and after administration of vasoactive drugs (dopamine, dobutamine, nitroglycerine, etc)? (123)[a]	108 (87.8)	9 (7.3)	4 (3.3)	2 (1.6)
Do you respect the rate of infusion of solutions for IV administration (such as chemotherapy, antibiotics, amines, heparin, etc.)? (123)[a]	113 (91.9)	9 (7.3)	1 (0.8)	0
Do you follow the 6 ″rights of medication administration″ (medication, right patient, right dose, right time, right route, documentation, etc)? (123)[a]	114 (92.7)	8 (6.5)	1 (0.8)	0

Do you dispose materials in dedicated containers after administration? (123)[a]	113 (91.9)	7 (5.7)	3 (2.4)	0
Do you perform a double check to verify the correct correspondence between prescription, preparation and administration of IV drugs, before administration? (122)[a]	95 (77.9)	19 (15.6)	8 (6.5)	0

[a] Number of nurses responding to the question.

Training Needs

Nurses were asked in the questionnaire how they consider their own knowledge level about IV drug preparation and administration. Only 22.8% answered that their knowledge level is great, for 64.2% it is good, for 12.2% it is sufficient and for 0.8% it is insufficient.

Consistent with literature data (21), 95.1% consider it fundamental to improve their knowledge about IV drug preparation and administration in order to reduce medication errors.

Academic training should increase the content on the safe use of drugs. (7) 94.3% of nurses in our study agree that good knowledge on the use of IV drugs can contribute to reduce medication errors.

One more considerable aspect is the cooperation between newly employed nurses and experienced nurses in order to prevent medication errors in ICUs. (22)

Almost all respondents (99.2%) in our sample considered the presence of newly hired nurses fundamental to the prevention of errors.

Table 5. Predictors of nurses' knowledge, attitudes and behaviour on the prevention of medication errors.

VARIABLES	OR	95% CI

Model 1: *Predictors of errors' knowledge towards medication.* [a]

Age (continuous)	0.97	0.81 -1.16
Gender (Male=0; Female=1)	0.69	0.18 -2.68
Years of work (<1=0;1-5=1;6-10=2; >10=3)	1.14	0.84- 1.19
Year of graduation from basic study (continues)	0.90	0.68- 1.89
Educational qualification (No degree=0; degree=1)	4.90	0.32- 72.87
Hours per week dedicated to bibliographical updating (<1=0;1-5=1;6-10=2; >10=3)	1.20	0.50- 2.94

Model 2: *Predictors of errors' attitudes towards medication.* [b]

Age (continuous)	1.04	0.94- 1.15
Gender (Male=0; Female=1)	2.45	1.07- 5.71
Years of work (<1=0;1-5=1;6-10=2; >10=3)	0.94	0.85- 1.05
Educational qualification (No degree=0; degree=1)	1.13	0.30- 4.31
Predictive knowledge on IV medication for the prevention of errors unadequate=0; adequate=1)	2.54	0.51- 12.73

Model 3: *Predictors of errors' behaviour towards medication.* [c]

		0.75-

Age (continuous)	0.92	1.12
Gender (Male=0; Female=1)	0.27	0.02-3.01
Years of work experience (<1=0;1-5=1;6-10=2; >10=3)	1.11	0.89-1.38
Predictive knowledge on IV medication for the prevention of errors (unadequate=0; adequate=1)	0.06	0.04-0.42
Predictive attitudes on IV medication for the prevention of errors (unadequate=0; adequate=1)	2.23	0.30-16.73

CI, Confidence Interval; OR, Odds Ratio.

[a]Grouped nurses who had correctly answered 7 of 8 questions on knowledge vs. everyone else

[b]Grouped nurses who had correctly answered all the questions on attitudes vs. others

[c]Grouped nurses who had correctly answered all the questions about behaviour vs. others

Validation of the questionnaire

As far as the 23 items from all three sections (knowledge, attitudes, behaviour) are concerned, the value of *Cronbach's alpha* is equal to 0.49, a low reliability value, demonstrating unsatisfactory internal validity.

The internal reliability for the eight items from the knowledge section has a reliability value of *Cronbach's alpha* equal to 0.50, that is, a minimum reliability level. Regarding the knowledge section, the low reliability value is probably due to the way the questions were asked, which were considered difficult to understand for many nurses, especially regarding the question on knowledge of computerized prescription drugs and the presence of a pharmacist during the

preparation of drugs. Only for the attitudes' section, was the reliability index higher than 0.78, well above the acceptable limit. (23)

The internal reliability for the eight items in the behaviour section has a minimum reliability value of *Cronbach's alpha*, which is equal to 0.51, that is an acceptable minimun level of reliability. 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. (18)

Results of the Bartlett's sphericity test (x^2=880.71; pV<0.001) suggest that we can perform efficiently a PCA (Principal Component Analysis) on the dataset.

Discussion

According to the report of the Institute of Medicine (IOM) in 2000, medication errors are supposed to be the cause of more than 7.000 deaths per year in the USA. (24) They represent the most common error class that can occur in hospitals. (25)

As has been confirmed in other studies, nurses in our survey are aware that change in rosters (double shifts, overtime, etc.), as well as workload, contribute to IV medication errors. One more aspect concerning ICUs, regards the alarm sounds and the ward emergecies which can cause distraction both in the preparation and administration of IV drugs.The working environment can be quite chaotic, with frequent interruptions as well as personnel changes. (26) Concerning the organizational climate, 87% of nurses confirmed that changes in rosters (double shits, overtime, etc.), as well as workload, contribute to IV medication errors. Moreover, alarm sounds and ward emergencies can cause distraction both during the preparation and the administration of IV drugs. Similar to data from the scientific literature, our study highlights that nurses (88.6%) are aware that appropriate knowledge on the calculation of medication dose is essential to reduce medication errors during the phase of drug preparation.

Abstoss KM, et al. (27) stated that the most implemented and recommended action to collect and record such alerts is the application of an *incident reporting* system. This is also confirmed by our study, which showed that 91.8% of nurses consider fundamental to report medication errors, in order to improve health care.

The majority of our survey (90.2%) stated that awareness of the prevention of errors and clinical risk management allegedly reduce errors during drug preparation and administration. This is also confirmed by Valentin and his colleagues in their study, (28) which showed that a safety culture in ICUs is associated with a reduction of medication errors.

A significant concern from our survey seems to be the poor adherence (38.2%) to the use of a dedicated room for the preparation of drug therapy. Some studies show, as an environmental problem, the constant interruptions nurses are subjected to during drugpreparation and administration. (29) Indeed, it is often necessary to concurrently handle a large amount of information. (30) A study showed that nurses are interrupted on average 1.2 times every time they are administering a drug. (31)

Other studies (32) recorded an interruption for every 3 drugs administered. There are other environmental factors that can affect the risk of error, such as: loud noises, poor lighting and untidy working areas. (33)

Although the literature (1) underlines a considerable reduction of errors related to the management of medication errors, by means of techonological implementations, including computer provider order entry (CPOE), administration through control of barcode as well as smart infusion pumps, the survey highlights nurses' lack of knowledge (13.1%) on CPOE.

Multivariate analysis stresses an interesting phenomenon: correct behaviour is associated with inadequate knowledge.This is probably due to the fact that, in a specialized area such as ICUs, long work experience

is associated with high competence and has a greater preventive effect on medication errors. (34) Multivariate analysis' results confirm that graduate nurses have more appropriate knowledge than those who are not. As a matter of fact, such appropriate knowledge is not related to appropriate behaviour and positive attitudes on management of IV drugs.

Knowledge about prevention of medication errors could be improved with specific training courses and with an increase in the time (hours) spent on reading the scientific literature. Only a small percentage (35%) of nurses in our survey spend time reading the literature.

An encouraging sign concerns the percentage of nurses who find it very important to improve their knowledge on the preparation and administration of IV drugs.

Conclusions

IV administration of drugs is one of the priority responsibilities of a nurse in the ICU. It is a key moment to intercept errors that have occurred in earlier phases of drug management, before they reach the patient.

The results of this pilot study are encouraging. Experience and competence gained by nurses in ICUs is crucial for implementing appropriate behaviour in order to prevent medication errors. (35) One more factor emerging from this study is the need for a knowledge-based clinical practice, as well as theoretical knowledge on IV drugs. Experience plays a key role, probably because it creates awareness of the need for respecting correct behaviour throughout the process in order to prevent medication errors.

Graduate nurses seem to have general theoretical knowledge, but not atdeeper levels to be able to use correct behaviour in specialized areas such as ICUs. (36)

The questionnaire will be amended, especially in the knowledge and

behaviour sections, where the *Cronbach's alpha was less than 0.7*. It will probably be related to the type of questions as well as the response method.

The number of involved nurses in the study is not high. Such contribution is only the starting point of an Italian multi-center study which aims to stress the predictors of medication errors in ICUs.

Acknowledgment

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