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Original Article

## Evaluating knowledge, attitude and practice of intensive care unit nurses in administering medications via enteral tubes

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### Abstract

The purpose of this study was to evaluate Intensive Care Unit nurses' knowledge, attitude, self-reported practice and observed practice, regarding medication administration via enteral feeding tube. In this cross sectional study, a questionnaire and a checklist was developed to evaluate the nurses' knowledge, attitude, self-reported and actual practice, regarding medication administration via enteral feeding tube. Mean score of knowledge, and the percentage of different domains of attitude and practice was reported. Fifty three nurses were included in this study. The mean  $\pm$  SD number of medications prescribed for each patient was  $15.8 \pm 4.5$ . From these medications,  $5.5 \pm 2.8$  drugs were administered via enteral feeding tube. There were few nurses (5%) with proper knowledge regarding correct dosage form selection. About half of the nurses had proper knowledge regarding tube flushing and drug dilution; however according to the direct researcher's observation, only 11% of nurses flushed the tubes before medication administration. The current study showed the disparity between the nurses' knowledge, self-reported practice, and proper performance in drug administration through enteral feeding tube. The most important problem in knowledge and attitude of nurses was in crushing the dosage forms and in actual practice, it was mainly in diluting medications and the process of tube flushing.

**Keywords:** Attitude, Drug administration, Enteral feeding, Knowledge, Nurses, Professional practice.

### 1. Introduction

Administering medication through enteral feeding tubes is one of the key responsibilities of nurses (1) that is a complex process which includes verifying tube position, preparing medications, flushing the tube, and assessing its potential complications (2).

The dosage form of medications, dilution process and the syringe size are important considerations in drug administration through enteral feeding tubes. There are two forms of medications to be administered via enteral feeding tubes: solids and liquids. Liquid dosage forms may have less potential for tube occlusion compared to solid dos-

age forms, however the risk of diarrhea occurrence with liquid dosage forms is more than solid dosage forms due to their sorbitol content (3-5). Methods of crushing solid dosage forms are different and some forms can not be grinded (6).

If medications are not appropriately given via enteral route, it may result in harmful consequences. These consequences include tube occlusion, diarrhea, aspiration pneumonia, drug inefficiency, drug side effects and even mortality; all of which can lead to an increase in patients' usage of hospital equipments and also length of stay, resulting in an increase in costs of healthcare system. Therefore, this demands a more efficient performance by the nursing staff in order to achieve an optimum result (1, 2).

This study was designed to evaluate

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knowledge, practice and attitude (KAP) of nurses working in Intensive Care Units (ICU) of a large teaching hospital, concerning recommendations for correct administration of medication, through enteral tubes.

## 2. Material and methods

### 2.1. Objectives

This was a cross-sectional, observational study aiming at evaluating ICU nurses' KAP regarding medication administration via enteral feeding tube in Nemazee hospital, the main referral center for patients in southern Iran, from February to July 2014.

### 2.2. Participants

Study population was determined according to similar studies (7-9) and by consulting with a biostatistician; Finally the population of the study was decided to be 60 nurses. Fifty three out of 60 nurses consented to participate in the study and filled out the questionnaires through interviewing, after having been ensured of the confidentiality of the presented information. The study was carried out in 7 ICUs, based on the number of beds, patients with enteral tube, and nurses. An overall number of 14 nurses in General ICU, 8 in Surgical and Central ICUS, 9 in Pediatric ICU, 7 in Neonatal ICU, 8 in Internal ICU and 7 nurses in the Neurosurgery ICU were selected randomly.

### 2.3 Setting

The study comprised of two parts; in the first part, nurses' practice regarding medication administration via enteral feeding tubes, was observed directly by the investigator for at least 3 times and all observations were recorded; in the second part, the participants received the questionnaire and answered the questions accordingly.

In the first page of the questionnaire, the purpose of the study was described, and it was mentioned that data would be analyzed confidentially. It was mentioned that participation is regarded as voluntarily and anonymously. This project was approved by the ethics committee of Shiraz University of Medical Sciences.

### 2.3. Data collection

We used a questionnaire and a checklist in our study. A 50-item questionnaire was developed following an extensive literature review and it was primarily based on the findings of similar studies (7-9). The validity of the questioner was evaluated and confirmed by a professor who is an expert in survey design. The reliability of the questionnaire was also evaluated by 2 nurses and its mistakes were corrected. During the study, the probable problems of the questionnaire were found and the final clarified questionnaire was resolved.

The questionnaire had three parts including nurses' knowledge (31 items), nurses' attitude (9 items) and nurses' self-reported practice (10 items). Descriptive question was about self-reported practice and described a common situation for nurses, and since most of the nurses did not answer this question, it was omitted from the study.

#### 2.3.1. Knowledge

The questions regarding nurses' knowledge comprised of the following topics; medication preparation (solid form crushing) (8 items), drug-food and drug-drug interaction (3 items), tube flushing and drug dilution (2 items) and Correct dosage forms selection (sustained release, controlled release and other dosage forms (18 items).

#### 2.3.2. Self-reported practice

The questions regarding Self-reported practice included drug-food and drug-drug interaction (2items), tube flushing and drug dilution (2 items), medication preparation (solid form crushing) (2 items), checking tube position (1 item), medication administration via small-bore tubes (1 item) and methods for opening occluded tubes (1 item).

#### 2.3.3. Attitude

Questions regarding attitude consisted of factors that affect drug administration (4 items), ways of improving the quality of medication administration services (4 items) and reliable person for answering medication administration via enteral feeding tubes problems (1 item).

Demographic information including sex,

**Table 1.** Demographic information of critical care nurses (n=53) in the study.

<b>Gender (%)</b>	
Men	5 (9.4%)
Women	48 (90.6%)
<b>Level of nursing education (%)</b>	
Diploma	1 (1.9%)
BS	49 (92.5%)
Master	3(5.7%)
<b>Years of practice experience as a nurse(Mean <math>\pm</math>SD)</b>	
Total experience	5.8 $\pm$ 4.6
Years of practice in the special ICU	4.0 $\pm$ 3.1

BS :Bachelor of Science , ICU : intensive care unit.

years of experience and nurses' level of education were also included in the questionnaire.

Our checklist was developed in order to evaluate the nurses' practice of drug administration via enteral feeding tube, based on direct observations. The checklist had three parts; in the first part, demographic information about patients and their medications were collected. In the second part, the investigator (an educated pharmacist) wrote his observations about medication administration through enteral feeding tube by nurses, and the third part was developed to evaluate the nurses' practice about drug administration via enteral feeding tube, based on direct observation. Criteria selected for the checklist were also extracted from an extensive literature review. The third part of the checklist consisted of 22 items (14 yes/no questions and 6 multiple questions) that were divided into different categories and it took about 15 minutes to answer all the questions. These different categories included medication preparation (how nurses prepare and administer drugs) (7 items), drug-Food and Drug-drug interaction (3 items), tube flushing and drug dilution (4 items), safety considerations in drug administration via enteral feeding tube (1 item), how nurses open occluded tubes (2 items), how to determine the correct tube position (1 item), type of liquid used for tube flushing and drug dilution (2 items), crushing unsuitable drugs (1 item) and patient restrictions in consumption of liquid (1 item).

#### 2.4. Data analysis

The Statistical Package for Social Science (SPSS, Chicago, IL, USA), version 18, was used for data analysis. The mean  $\pm$  standard deviation (SD) of total correct answers to the knowledge and practice questions was regarded as nurses' knowledge and practice score. In each domain, if more than 60% of the questions were answered correctly, it was considered as an acceptable knowledge. As for attitude and practice score, the percentage of nurses having given the desired answer, was reported for each question.

#### 3. Results

At the end of the study, 53 nurses and 68 patients were included; more than 90% (48) of nurses who participated were women and more than 92% (49) of them had bachelor's degree in nursing practice. The mean average of working experience in different ICUs was more than 5 years and their experience in their current ICU was about 4 years. Table 1 shows demographic information about the participants. The mean  $\pm$  SD number of medications prescribed for each patient was 15.8 $\pm$ 4.5. From these medications, 5.5 $\pm$ 2.8 were administered via enteral feeding tube. Orange Nasogastric tube was used more frequently than other types of tubes for patients and N-acetyl cysteine, atorvastatin, aspirin, folic Acid and multivitamin were administered for more than 20% of the patients.

**Table 2.** Critical care nurses' knowledge regarding the different aspects of drug administration via enteral tube (n=53).

Knowledge question categories	Mean $\pm$ SD <sup>†</sup>	Number (%) of nurses with proper knowledge
Medication preparation	6.7 $\pm$ 1.5	16 (30%)
Tube flushing and drug dilution	5.5 $\pm$ 3.0	27 (50%)
Drug-food and drug-drug interaction	4.6 $\pm$ 3.0	28 (52%)
Correct dosage form selection	5.1 $\pm$ 1.2	3 (5%)

<sup>†</sup>Maximum score for each domain was 10.

<sup>‡</sup>In each domain, if more than 60% of the questions were answered correctly, it was considered as an acceptable knowledge.

### 3.1. Knowledge analysis

In Table 2, the average score of the participants' knowledge in different aspects and domains has been shown. This table shows that about half of the nurses have acceptable knowledge with regards to tube flushing, drug dilution and drug-food and drug-drug interactions, and 30% of the participant's knowledge was acceptable concerning medication preparation and the worst score was related to correct dosage form selection (5%).

### 3.2. Practice analysis (Self-reported questions)

In medication preparation (crushing solid dosage forms), the nurses had the worst practice (Table 3). More than 95% of the participants used auscultation method in order to check tube placement. In 47.1% of the nurses, the size of the tubes was not considered as an important issue when they administered medication, 40.8% of nurses administered medications slower when using small bore tubes, and 12.2% of them diluted the medications more than usual. According to self-reported practice by nurses, when a tube gets clogged, most of the nurses (44.2%) flush the tubes with warm water, but none of them use anti-clogging agents. (Table 4).

### 3.3. Practice analysis (observed by the investigator)

Nurses' practice observed by the investi-

gator showed that their practice in tube flushing and drug dilution was worse than other categories (Table 5). 62.2% of the participants started enteral nutrition 15-30 minutes after medication administration (Table 6). When the tube was clogged, 75% of them increased pressure using the syringe method. More than half of (52.8%) the participants used drinking water for diluting medications administered via enteral feeding tube. However, 28.0% of the nurses did not check the tube position before administrating the medication (Table 6). In our study, 54% of nurses wore gloves and mask during drug administration.

### 3.4. Attitude analysis

With regards to administering drugs via enteral feeding tube, 43.1% of the participating nurses believed that a physician is the best person to ask questions, 31.4% believed hospital pharmacist, and 19.6% believed the head nurse is the best person to answer their questions. 67.9% of the nurses indicated that general condition of patients is the most important factor that influences the amount of liquid volume used for diluting medication. In order to improve medication administration via enteral tube, 83% thought that educational classes during their work experience can be effective, 78.8% believed collaboration between nurses, physicians and pharmacists should increase,

**Table 3.** Critical care nurses' self reported practice regarding the different aspects of drug administration via enteral tube (n=53).

practice question domains	Mean score	Number (percent) of nurses with proper practice
Medication preparation	4.3 $\pm$ 2.0	5 (9%)
Tube flushing and drug dilution	8.2 $\pm$ 1.5	36 (67%)
Drug-food and drug-drug interaction	7 $\pm$ 1.7	21 (39%)

<sup>†</sup>Maximum score for each domain was 10.

**Table 4.** The percentage of nurses using each method in different situations during medication administration via enteral feeding tube (n=53).

	Nurses Number (%)
<b>Checking tube position</b>	
pH testing	2(4.0%)
Air Auscultation	51(96.0%)
<b>Drug administration via small-bore tube</b>	
More drug dilution	6(11.3%)
Slow drug administration	21(39.6%)
More tube washing	1(1.8%)
No difference in practice	25(47.1%)
<b>Opening tube occlusion</b>	
Increase tube pressure by syringe	13(24.5%)
Washing with warm water	24(45.2%)
Using anti clog agents	0(0.0%)
Tube changing	16(30.1%)

58.5% stated that if nurses' knowledge about different dosage forms of drugs increases, it will have a positive effect on improving medication administration via enteral feeding tube and only 4% believed that hospital restriction for choosing the dosage forms by physicians can be effective in improving drug administration.

#### 4. Discussion

Our study showed undesirable results in the nurse's KAP towards drug administration via enteral tube.

##### 4.1. Knowledge

In the present study, we found inadequate level of knowledge concerning drug administration via enteral tube in the observed nurses. Our findings confirm previous results in other studies

on the nurse's knowledge of administering drugs through enteral tube before providing the appropriate level of education (10-15). It indicates that there is a need to establish workshops with collaboration between pharmacists and nurses to increase the nurses' knowledge on this subject.

Nurses should pay attention to the dosage forms when administering enteral medications. Medications that should not be crushed and administered through a tube include enteric coated or sustained release tablets, soft gelatin capsules and pellets inside microencapsulated dosage forms (13-14). Nurses' knowledge about the codes which refer to sustained released or other mentioned dosage forms of drugs in our study, was less than half; this corresponds with results of other studies (7).

The most logical recommendation about admixing medications with enteral feeding for-

**Table 5.** Mean scores in different nurses' practice domains observed by investigator in drug administration via enteral tube (n=53).

practice question domains	Mean score†
Medication preparation	5.0±1.7
Tube flushing and drug dilution	2.1±1.4
Drug-food and drug-drug interaction	5.6±2.7

†Maximum score for each domain was 10.

**Table 6.** Number (percent) of nurses using each method in different situations during medication administration via enteral feeding tube. (Each situation has its own population).

<b>Nurse number (precent)</b>	<b>Situation(population)</b>
<b>Checking tube position (n=53)</b>	
Without checking	15 (28.3%)
Gastric residue aspiration	8 (15.1%)
Air Auscultation	22 (41.5%)
Aspiration and Auscultation	6 (11.3%)
Other methods	2 (3.8%)
<b>Liquid for dilution and dissolving medication (n=53)</b>	
Drinking water	28 (52.8%)
Distilled water	8 (15.1%)
Boiled, cooled water	16 (30.2%)
juice	1 (1.9%)
<b>Opening tube occlusion (n=12)</b>	
Increase tube pressure by syringe	9 (75%)
Washing with warm water	2 (16.7%)
Tube changing	1 (8.9%)
<b>Time between nutrition and medication administration (n=45)</b>	
Without gap	11 (24.4%)
Nutrition and medication mixed	6 (13.3)
Nutrition given 15-30 minutes after medication administration	26 (62.2%)

mula is to avoid the routine admixture whenever possible, due to the decreased drug bioavailability or the possibility of tube occlusion (13-14). In a study by Hanssen *et al.*, the nurses' proper knowledge in this field was 51%; in our study, it was 50.8%. Kenny *et al.* reported that in the drug-drug interaction domain, before education and intervention, 45% of the nurses had proper knowledge (15). In our study, 52% of the nurses had proper knowledge in this domain. Nurses' knowledge should be increased in this field for appropriate administration and reduction of the possibility of interactions.

#### 4.2. Attitude

Similar to other studies our findings also showed that nurses' attitude towards medication administration via enteral tube is inappropriate (16).

In medication administration via enteral feeding tube, the nurses need the best available source of information to improve their practice and

reduce their mistakes. Belknap *et al.* showed that the main source of information for 56.9% of the nurses was their personal experience and 21.7% of them consulted with their coworkers (16). In our study, 43.1% of the nurses thought that the physician is the best person to answer their questions and 34.1% believed that the pharmacist is the best option.

Proper tube placement is very important for better drug absorption and less adverse reactions. Nurses use different methods for checking the correct placement of the tube; the most reliable method for accurate tube placement is radiography (17). In the Gupta *et al.* study, 79% of nurses declared using air auscultation method for checking the proper placement of the end of the tube (18). Chan *et al.* reported that 76% of nurses, when in doubt, used two methods for checking tube placement and pH testing was a common method for checking tube placement in their hospital (19); in our study 96% declared using pH testing method

for checking tube placement. When the investigator checked the nurses' work, it was shown that 41.5% of the nurses used air auscultation and 28.3% did not pay attention to correct tube placement.

### 4.3. Practice

In our study nurses' practice about medication administration via enteral tube was not satisfactory. In the Mota et al study, 21% of the nurses never crushed sustained release dosage forms (9). In our study, 100% of nurses crushed drugs when physicians prescribed them, even if they were not crushable. This failure of practice may be related to authority of our physicians in prescribing and choosing medication dosage forms.

When nurses administered drugs through enteral tube, hygienic measures, like wearing gloves, were very important because it can reduce the chance of infection. In a study conducted by Triki et al, gloves were not worn in 80% of the observations (10). In our study, 54% of nurses wore gloves, used masks during drug administration, and paid attention to these measures. If nurses pay attention to these factors, the chance of transmitting infection will be reduced.

For a proper administration, each medication should be administered separately by enteral tube; separate administration decreases drug-drug interactions and reduces the chance of medication interactions. Some drugs shouldn't be mixed; mixing can affect the physicochemical stability and have an effect on their absorption and interaction with other drugs (13-14). In a study by VandenBemt et al, which was conducted in two Dutch hospitals, 36 (38%) of nurses mixed different medications (6), while in our study according to the investigator's observation 72% of nurses mixed medications and this could be the cause of many problems such as in appropriate absorption, adverse interaction, and instability of drugs.

Tube flushing with 30 ml of water decreases the chance of tube occlusion, incompatibility between tube and medications, and washing residues from the last administration (1). VandenBemt et al reported that no one flushed the tube before medication administration (6). In the Kenny et al study, in drug dilution and flushing domains,

25% of the participants flushed the tubes before medication administration (15). Also in the Mota et al study, 28% of nurses flushed the tubes before drug administration while 96% flushed the tubes after medication administration (9). In our study, 11% of nurses flushed the tubes before medication administration where as 67% flushed the tubes after medication administration according to our investigator's observation.

Different methods have been used in order to remove tube occlusion. Flushing with warm tap water alone is a successful method. The methods for opening the occluded tubes should be done so that it decreases changing of tubes. In the study conducted by Mota et al, 38.1% of nurses flushed the tubes with warm water and 47.7% increased tube pressure by syringe (9) while in our study, 44.2% flushed the occluded tubes with warm water, 25% increased tube pressure by syringe, and 30.8% of nurses changed the tubes. None of the nurses used pancrelipase along with increasing the pH to 7.9 by the use of sodium bicarbonate (9).

The simultaneous administration of medications with enteral nutrition can result in alterations in the medication's bioavailability and change in drug pharmacologic effects. In a study on nursing practice, 7% of the nurses stopped enteral feeding for 15 min after medication administration, 34% stopped it for 20 min, and 53% for 30 min, and 12% for 1 hour (20). In the current study, according to our investigator's observations, 62% of nurses stopped enteral feeding 15-30 min before and after medication administration and 24% of the nurses started feeding immediately after medication administration.

The cause of the difference between the results of our study and other studies can be as follows :in our study the results were obtained from direct observations by a researcher ,which is certainly more valuable than when the data is self-reported by nurses. Also in this study not only the practice of nurses but also their knowledge and attitudes has been studied at the same time. In most hospitals in our study, intensive care units are small and the number of patients that use enteral nutrition is limited. Regarding the evaluation of nurses by researchers in several stages, in the proceeding stages, there was no access to a number of

nurses for various reasons such as their transfer to other departments, therefore such nurses had to be excluded.

A majority of studies used only a questionnaire and trusted the nurse's personal statement which may be different from the real practice, but in our study we checked the nurse's performance by both direct observation and questionnaire. This type of study can reveal the differences between what the healthcares know and what they do in real practice. Compared to other studies on the same topic, our study consists of more different aspects of drug administration via enteral feeding tube. Researchers are recommended to conduct studies using this method in other hospitals.

This study had some limitations: the small sample size and also lack of outcome measures, such as the incidence of complications and the rate of tube occlusion.

## 5. Conclusion

According to our findings, most of the nurses, during drug administration relied on their own information and experiences. The current study showed considerable disparity between the nurses' knowledge, self-reported practice, and proper performance. The most important problems

in knowledge and attitude of nurses included crushing the dosage forms and in the actual practice it was mainly attributed to the domains of diluting medications and tube flushing. This may be related to the lack of proper evidence-based guidelines for medication administration via enteral feeding tubes, low level of education in nurses and physicians in these aspects, and shortage of cooperation between pharmacists, physicians and nurses. Therefore, in order to improve drug administration via enteral feeding tubes, we should implement some new guidelines and educational courses to improve the nurses' knowledge and practice in this domain.

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## Conflict of interest

None declared.

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