Nurses' knowledge and practice concerning fluid and electrolyte balance among patients with congestive heart failure

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Abstract :

Background: Critical care nurses have a vital role in identifying and treating the physiologic stressors experienced by critically ill patients that disrupt homeostasis such as the patients with Congestive Heart Failure (CHF). **Aim of the study**: to assess nurses' knowledge and practice concerning fluid and electrolytes balance among patients with congestive heart failure and investigating the relation between their knowledge and practice. **Subjects and Methods**: **Research design**: Cross-sectional analytic design. **Setting:** The study was carried out at Zagazig Main University Hospital .**Subjects**:160 nurses and 160 CHF patients .**Tools of data collection**: a self-administered questionnaire sheet and an observation checklist. **Results:** nurses' knowledge about CHF and related fluid/electrolytes balance was high, with an overall good percentage having total satisfactory knowledge. The practice was deficient regarding assessment of peripheral circulation, skin and mucous membranes, signs of altered tissue perfusion, ineffective breathing pattern, and alteration in fluid balance. Nurses' knowledge was positively influenced by their age, and female gender. The practice was negatively influenced by the knowledge score and the number of medications taken by the patient, and the knowledge and practice scores are negatively correlated. **Conclusion**: Hence, nurse's age and gender as well as the attendance of training courses are the factors influencing their knowledge, while the factors affecting practice are their knowledge and the number of medications given to patients. In conclusion, nurses' knowledge about CHF and related fluid/ electrolytes balance is variable, with an overall good percentage of total satisfactory knowledge. The practice is generally higher. The knowledge and practice scores are negatively correlated and the training courses have a negative influence on nurses' knowledge. **Recommendations**: The nurses working with patients with CHF improve their knowledge, particularly the younger ones. The content and process of training courses need to be revised, with more focus on applied knowledge.

Keywords: Congestive heart failure, Fluid-electrolyte balance, Critical care nursing , knowledge , practice

Introduction

Heart failure is a global term for the physiological state in which cardiac output is insufficient in meeting the needs of the body and lungs. Congestive heart failure (CHF) occurs when the heart is unable to provide an adequate blood supply for the body's organs [1].It is most commonly caused when cardiac output is low and the body becomes congested with fluid due to an inability of heart output to properly match venous return [2].Acute decompensated heart failure is exacerbated or decompensated heart failure, referring to episodes in which a patient can be characterized as having a change in heart failure signs and symptoms resulting in a need for urgent therapy or hospitalization [3].

Electrolytes have many functions, such as regulating heart rhythms and affecting the amount of water retained in your body. In conditions such as CHF, excess sodium causes water retention leading to edema [4].Fluid and electrolyte balance play an important role in homeostasis, and critical care nurses assume a vital role in identifying and treating the physiologic stressors experienced by critically ill patients that disrupt homeostasis [5].Values for the normal daily intake and

output of fluid and electrolytes are only an approximate guide and may have to be modified in the presence of excessive losses, e.g. of water and salt through increased sweating and insensible loss in hot climates. They may also need to be modified in the presence of disease, e.g. gastroenteritis, which causes abnormal losses of fluid and electrolyte from the GI tract [6].

Under normal circumstances most of fluid intake is oral, but all food contains some water and electrolytes. The drinking behavior is governed by the sensation of thirst, which is triggered whenever water balance is negative through insufficient intake or increased loss. It may also be triggered by a high salt intake, which necessitates the intake and retention of extra water in order to maintain the ECF sodium concentration and osmolality in the normal range [7]. Although, in the elderly, the thirst mechanism becomes blunted, it ensures, on the whole, that intake matches the needs of bodily functions, maintaining a zero balance in which intake and output are equal and physiological osmolality is maintained [8]. Age and disease can impair the renal concentrating capacity so that a larger volume of urine is required in order to excrete the same amount of waste products [9].

Just as too little or too much of any one electrolyte can become a problem in maintaining a critically ill patient's stability; imbalances in fluid homeostasis can also present unique challenges for both the nurse and patient [4].Electrolyte disorders result in an imbalance of minerals in the body. For the body to function properly, certain minerals need to be maintained in an even balance. Otherwise, vital body systems, such as the muscles and brain, can be negatively affected [10].Therefore, patients with advanced chronic kidney disease, liver disease or underlying respiratory disease are at increased risk of developing acid-base abnormalities at times of acute illness [11].Specific patient

management will depend upon the clinical status of the patient and correction of the underlying cause [12].

Critical care nurses are responsible for delivering prescribed nutrition, fluid and medication safely and effectively to CHF patients [13].Nursing interventions include assessment, monitoring of vital signs, skin temperature and peripheral pulses, results of lab investigation, and oxygen saturation, implementing strategies to treat fluid and electrolyte imbalances, and instructing patient to get adequate bed rest and sleep [2].

Significance of the study :

The problem of fluid and electrolyte imbalance is critical, particularly in CHF patients who usually do not require long-term hospitalization but need good care, with compliance to a therapeutic regimen for maintenance of adequate fluid and electrolyte balance for life. Otherwise, they may suffer serious problems with that may be fatal. The nurse has an important role in helping these patients to comply with their treatment regimen. This study is an attempt to determine the factors affecting the role of the nurse in maintaining adequate fluid and electrolyte balance among patients with CHF. These factors may include lack of knowledge or inadequate practice.

Aim of the study:

To assess nurses' knowledge and practice concerning fluid and electrolytes balance among patients with congestive heart failure.

Resarch question:

1. What is nurses' knowledge concerning fluid and electrolyte balance among patients with congestive heart failure?
2. What is nurses' practice concerning fluid and electrolyte balance among patients with congestive heart failure ?

SUBJECTS AND METHODS

Research design:
This cross-sectional analytic design was used.

Study setting;
This study was carried out at Zagazig University Hospitals in medical and cardiac units.

Study subjects:
The study involved two groups of subjects namely nurses and patients. The nurses group consisted of a systematic random sample of 160 nurses working in the study settings with at least one year experience in the current job. The patients group consisted of 160 patients hospitalized in the study setting during the period of the study with definite diagnosis of CHF. Critically ill patients whose health status makes them unable to participate were excluded.

Tools of data collection:
The data for the study were collected using a self-administered questionnaire and an observation checklist. The self administered questionnaire included a part for nurse's demographic and work data, and a part for assessment of knowledge based on Frangiosa et al & Stewart [14 ,15].It included open and closed questions covering the areas of CHF, fluid and electrolytes balance, and the role of the nurse in the management of fluid and electrolytes imbalance in CHF patients. For each knowledge question, a correct answer was scored 1 and the incorrect zero. The scores were summed-up and converted into a percent score. The nurse's knowledge was considered satisfactory if the percent score was 60% or higher and unsatisfactory if less than 60%.

The observation checklist included a part for patient's socio-demographic data, a part for medical history, a checklist for the audit of nursing documentation of patient's vital signs, CVP, fluid balance, blood gases, ECG, and body weight, and an observation checklist to assess nurse's practice in dealing with CHF patient. It assessed 15 areas of practice, with each area having a number of items to be checked as "done," "not done," and "not applicable." The items observed to be done were scored "1" and the items not done were scored "0". The "not applicable" items were not scored and were not counted in the totals. For each area, the scores of the items were summed-up and converted into a percent score. The practice was considered adequate if the percent score was 60% or higher and inadequate if less than 60%.

Content validity:
Face and content validity were done for the tools by five expertises in the field of Medical-Surgical Nursing, and necessary modifications were done.

Fieldwork:
The actual fieldwork started in September 2013 and was completed by the end of May 2014. After fulfilling the required administrative steps, the researcher went to the study setting and conducted meetings with the potential participants to give them a brief idea about the purpose of the study and the data collection procedures. The questionnaire sheets were distributed to those who agreed to participate. After filling, they were collected by the researchers who reviewed them to ensure completion.

After filling out the self-administered questionnaire sheet, each participant nurse was instructed that she/he will be observed by the researcher while providing care for the patients with congestive heart failure and managing their fluid electrolytes balance. The observation was carried out during the morning and afternoon shifts. The process lasted for the whole shift or sometimes more than one shift to be able to cover all the areas of observation according to the designed checklist.

Pilot study:
A pilot study was carried out on a group of 20 nurses and 20 patients to test the applicability of the tools and the

clarity of the questions. Minor modifications were done according to the results of the pilot, in the form of rephrasing some items. Then, the final versions of the tools were developed. The subjects included in the pilot study were not included in the main study sample.

Administrative & ethical considerations:

The aim of the study was explained to the subjects (nurses and patients) and their approval to participate in the study was taken through informed oral consents. They were informed of their rights to refuse or withdraw at any time with no reason given. Confidentiality of any obtained information was ensured, and the questionnaire forms were anonymous. The study procedures could not entail any harmful consequences on participants.

Statistical analysis:

Data entry and statistical analysis were done using SPSS 16.0 statistical software package. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of nurse's knowledge and practice scores multiple linear regression analysis was used after testing for normality, and homoscedasticity, and analysis of variance for the full regression models were done. Statistical significance was considered at p-value <0.05.

Results :

The socio-demographic characteristics of the nurses in the study sample .**Table (1**) : shows that the majority consisted of females (88.8%) and married (78.1%). Slightly more than half of them (54.4%) had their age below 30 years, with mean±SD 31.1±9.0 years. Two-fifth of them (40.0%) were having a bachelor degree. Their working experience ranged between 1 and 43 years, with

less than two thirds (62.5%) having less than 10 experience years. Only 26.3% of the nurses in the study sample had attended training courses in Congestive Heart Failure (CHF), and 16.9% in fluid /electrolyte balance.

Concerning the socio-demographic characteristics of the patients in the study sample, **Table 2** indicates that more than half were males (56.3%), and their age ranged between 18 and 85 years, with slightly more than one-third of them (37.5%) having their age 60 years or older (62.5%). The majority of the patients were married (73.1%) and unemployed (61.9%), and more than two-fifth (43.8%) were illiterate, with a slight preponderance of rural residents (58.8%). Only less than one-third (31.9%) of the patients considered their income as insufficient; meanwhile 28.1% of them were saving. Concerning patients' smoking habits, less than two-thirds (65.6%) were non-smokers, while only one-fifth (20.0%) were current smokers. The majority of the patients were taking more than one medication (83.1%), with a median of 4.

Table (3) : shows a variability of the nurses' knowledge of various areas regarding congestive heart failure and fluid and electrolyte balance among nurses in the study sample. It shows that the highest percentage of satisfactory knowledge was related to the nurse role (80.0%). On the contrary, the lowest percentage (36.3%) was related to knowledge about fluid and electrolyte balance in CHF. Overall, 60.0% of the nurses in the study sample had a total satisfactory knowledge.

Table (4) : summarizes the total practices of fluid and electrolyte balance care among nurses in the study sample. It indicates that the highest percentages of adequate practice were related to the assessment of patient's nutrition (91.3%), the care for the patient receiving diuretics (90.0%), and the vital signs (84.4%). On the contrary, the lowest percentages of adequate practice were related to the assessment of

peripheral circulation (42.1%), evaluation of skin and mucous membranes (52.2%), checking for signs of altered tissue perfusion (57.5%), signs of ineffective breathing pattern (56.9%), and signs of alteration in fluid balance (59.4%). Overall, 85.0% of the nurses had total adequate practice.

Table (5): indicates the presence of a statistically significant weak negative correlation between nurses' scores of knowledge and practice (r=-0.218). Meanwhile, nurses' knowledge score had a statistically significant weak positive correlation with their age (r=0.321) and patient's number of diseases (r=0.163). On the other hand, nurses' practice score had a statistically significant weak negative correlation with patient's number of diseases (r=-0.171) and number of medications (r=-0.176).

Table (6) : presents the best fitting regression model for nurses' score of knowledge. It indicates that nurse's age was the only statistically significant positive predictor of the knowledge score. Meanwhile, nurse's female gender and the attendance of courses in CHF were negative predictors. The model explains 17% of the variation on the knowledge score as indicated by the r-square value. None of the other nurse's characteristics influenced their knowledge score.

Concerning nurse's score of practice, the table shows that the nurse's knowledge score and the number of medications taken by the patient were the only statistically significant negative predictors. The model explains 10% of the variation in the practice score as indicated by the r-square value. None of the other nurse's or patient's characteristics influenced their practice score.

Discussion :

The most common fluid and electrolyte problems that confront both chronically and critically ill patients are disturbances in sodium and water balance. Thus, it is important for the infusion therapy nurse to understand the basic pathophysiology of sodium imbalances as well as therapeutic approaches for their correction Wunderlich [16].The aim of this study was to assess nurses' knowledge and practice concerning fluid and electrolytes balance regarding patients with CHF and investigating the relation between their knowledge and practice. The findings indicate that nurse's age and gender as well as the attendance of training courses are the factors influencing their knowledge. Meanwhile, the practice is affected by their knowledge and by the number of medications they administer to their patients.

The current study findings demonstrated a positive influence on nurses' age on their knowledge. In fact, the scores of knowledge correlated positively with age, meaning that as the nurse's age increases she/he accumulates more knowledge. Moreover, the multivariate analysis identified nurse's age as a positive predictor of the knowledge score. This might also be due to that diploma degree nurses graduate at a younger age compared with the bachelor degree nurses, and thus the knowledge is better among older age ones. In agreement with this, Numminen et al [17].in their study in Finland demonstrated a statistically significant positive correlation between practicing nurses' age and their knowledge and competence.

Although the present study results demonstrated a positive correlation between nurses' experience years and their knowledge score, this relation was not shown in multivariate analysis. This means that the relation between nurses' experience years and their knowledge score was confounded by their age, which was identified as an independent positive predictor of this score. The finding of lack of adjusted relation between nurses' experience

years and their knowledge score is in agreement with Moceri and Drevdahl [18] .whose study in the United States (US) showed that the years of experience of nurses were not correlated to the number of correct answers they got.

According to the present study results, female gender turned to be a negative predictor of the knowledge score, indicating a better knowledge among male nurses compared to female ones. This might be explained by the fact that all or most of the male nurses are carrying a bachelor degree, while, on the contrary most female ones are diploma degree nurses. This could have a positive effect on male nurses' knowledge as they have a higher degree in education as shown by Godino et al [19].in a study of the role of the nurse in genetic health care in Italy.

Among the nurses of the current study, only approximately one-fourth reported having attended training courses in CHF, and a lower percentage attended courses in fluid/electrolyte balance. This is a very low percentage and it indicates a deficiency in staff development and continuing nursing education efforts in the study settings. The importance of such training in developing nurses' knowledge has been emphasized recently Limoges et al [20].However, an unexpected finding of the present study was the negative relation between nurses' attendance of training courses in CHF and their knowledge, and this was further confirmed in multivariate analysis. This might have two different explanations. The first relates to the training course content and/or process which might not respond to the needs of the participants, or might not motivate their active participation through adult learning procedures. In line with this first explanation, Ramoo et al [21].in a study in Malaysia attributed the success of their educational intervention to its content and process which emphasized hands-on practical training in addition to the theoretical knowledge.

The second possible explanation of the negative effect of training on the current study nurses' knowledge relates to the participants who might not be interested to attend due to personal factors such as the level of education, time, and family commitments, or work-related factors such as the process of selection or nomination to attend the training. In agreement with this, Mahendran et al [22].in a study in Singapore underscored the importance of paying attention to nurses' existing training and years of clinical nursing experience in any training course for staff development in increasing the effectiveness of such programs.

Overall, only slightly more than half of the nurses in the present study were having satisfactory knowledge about CHF and fluid/electrolyte balance. This is considered as a low level since these nurses provide care to critical cases, and thus should possess enough knowledge background to be able to provide a quality care for these patients. However, and in agreement with this finding, a study in the United States among clinical specialist nurses revealed a similarly low level of knowledge of heart failure among them Mahramus et al [23].The authors concluded that there is a need to develop interventions to improve nursing knowledge of CHF.

Concerning nurses' practice, the present study demonstrated a wide variation. Thus, the majority of the nurses had adequate practices in the areas of assessment and documentation of patients' vital signs, assessment of patient's nutrition and care for patients receiving diuretics. These areas are of major importance in the prevention of fluid and electrolytes imbalance. In agreement with this, Maristany and Segurola Gurruchaga [24].in a Spanish study emphasized that it is necessary that the nurse makes an early assessment of patients water needs to detect if there are signs of electrolyte imbalance. Although dehydration can be

a very serious problem, the key to having a proper hydration is prevention.

On the contrary, the nurses of the present study had deficient practices in the areas of assessment of peripheral circulation, and of skin and mucous membranes, checking for signs of altered tissue perfusion, of ineffective breathing pattern, and of alteration in fluid balance. The deficient practice in these areas is certainly due to the lack of knowledge as well as the lack of proper training in performing these actions. In fact, the training courses attended by these nurses had a negative impact on their knowledge rather than improving it. In line with this, Numminen et al [25] .in their study in Finland questioned whether the educational outcomes of nurse education meet the requirements of nursing practice. The purpose was to find competence areas contributing to the acknowledged practice-theory gap. Moreover, *Paul and Hice* [26] .in North Carolina stated that nurses' assessment skills and comprehensive knowledge of acute and chronic heart failure are important to optimize patient care and improve outcomes from initial emergency department presentation through discharge and follow-up.

According to the present study results, the practice of the nurses was not significantly influenced by any of their personal characteristics. However, the knowledge of the nurses had a negative and significant correlation to their practice, and it was identified as an independent negative predictor of the practice score. This is a quite surprising finding since knowledge is known to enhance and support practice. The only possible explanation is that the knowledge content these nurses acquire during their study years is not related to the practice, i.e. a gap between knowledge and practice may exist among these nurses. In line with this explanation, a recent study in the United States reported a similar student knowledge-practice gap as a major

theme of their study, which was consistent with studies of employer concerns of new graduate nurses *Ayers et al* [27].

The second factor identified in the present study as influencing nurses' practice was the number of medications administered to their patients. The findings indicate that the adequacy of practice is decreased with the increasing numbers of medications administered. This might be explained by the fact that with a larger number of medications there is a need for more attention for drug interactions and more care which may need more effort from the side of the nurse, or that a larger number of medications indicate a higher severity of the patient condition, thus necessitating more care. In agreement with this, Kothari and Ganguly [28] .in their study in India mentioned that drug-drug interactions are significant but avoidable causes of iatrogenic morbidity particularly in patients suffering from CHF. On the same line, *Sehgal et al* [29] .found that polypharmacy and larger number of medications were associated with hospital readmission.

Conclusion :

In conclusion, nurses' knowledge about CHF and related fluid/ electrolytes balance is variable, with an overall good percentage of total satisfactory knowledge. The practice is generally higher. The knowledge and practice scores are negatively correlated and the training courses have a negative influence on nurses' knowledge.

Recommendations :

In view of these results, it is recommended that the nurses working with patients with CHF improve their knowledge, particularly the younger ones. The content and process of training courses need to be revised, with more focus on applied knowledge. The nurses need more focused training in the areas of assessment of peripheral circulation and skin and mucous

membranes, and the identification of the signs of altered tissue perfusion, ineffective breathing pattern, and alteration in fluid balance, with more close supervision. Further research is proposed to assess the effectiveness of training programs fostering applied knowledge on nurses' performance.

Table 1: Socio-demographic characteristics of nurses in the study sample (n=160)

	Frequency	Percent
Age:		
<30	87	54.4
30+	73	45.6
Range	20.0-60.0	
Mean±SD	31.1±9.0	
Median	28.0	
Gender:		
Male	18	11.2
Female	142	88.8
Marital status:		
Single	30	18.8
Married	125	78.1
Divorced/widow	5	3.1
Nursing qualification:		
Bachelor	64	40.0
Nursing institute	38	23.8
Secondary nursing diploma	58	36.3
Experience:		
<10	100	62.5
10+	60	37.5
Range	1.0-43.0	
Mean±SD	9.7±8.7	
Median	7.0	
Attended training courses in:		
Congestive heart failure (CHF)	42	26.3
Fluid/electrolyte balance	27	16.9

Table 2: Socio-demographic and medical characteristics of patients in the study sample (n=160)

	Frequency	Percent
Age:		
<60	100	62.5
60+	60	37.5
Range	4.0-85.0	
Mean±SD	53.0±13.3	
Median	54.00	
Gender:		
Male	90	56.3
Female	70	43.8
Education:		
Illiterate	70	43.8
Read/write	16	10.0
Basic	11	6.9
Secondary	28	17.5
University	35	21.9
Marital status:		
Single	12	7.5
Married	117	73.1
Divorced/widow	31	19.4
Job:		
Unemployed	99	61.9
Clerical	32	20.0
Manual	29	18.1
Residence:		
Urban	66	41.3
Rural	94	58.8
Total number of medications:		
1	27	16.9
>1	133	83.1
Range	1-8	
Mean±SD	3.8±1.9	
Median	4	

Table 3: Nurses' knowledge about Congestive Heart Failure (CHF) and fluid and electrolyte balance among nurses in the study sample (n=160)

Satisfactory knowledge (60%) of:	Frequency	Percent
Fluid/electrolyte balance in CHF	58	36.3
Congestive heart failure (CHF)	91	56.9
Nurse role	128	80.0
Total knowledge:		
Satisfactory (60%+)	96	60.0
Unsatisfactory (<60%)	64	40.0

Table 4: Nurses' practice of fluid and electrolyte balance care among nurses in the study sample (n=160)

Adequate practice (60%+) of:	Frequency	Percent
Documentation	120	75.0
Vital signs	135	84.4
Assessment of peripheral venous circulation	67	42.1
Evaluation of the skin and mucous membranes	83	52.2
Assessment of patient's nutrition	146	91.3
Assessment of patient's response to exercise	110	68.8
Checking for signs of impaired gas exchange/ increased pulmonary interstitial fluid	108	67.9
Checking for signs of altered tissue perfusion	92	57.5
Checking for signs of ineffective breathing pattern	91	56.9
Checking for signs of alteration in fluid balance (excess)	95	59.4
Checking for signs of fatigue (imbalance between oxygen demand and supply)	99	61.9
Checking for signs of anxiety	119	74.4
Assessing patient's knowledge	133	83.1
Care of the patient with edema	114	71.3
Care of the patient receiving diuretics	144	90.0
Care of the patient receiving digitalis	123	77.4
Total practice:		
Adequate (60%+)	136	85.0
Inadequate (60%+)	24	15.0

Table 5: Correlation between nurses' knowledge and practice scores and their own and patients' characteristics

	Spearman's rank correlation coefficient	
	Knowledge score	Practice score
Practice score	-.218**	
Age	.321**	-0.11
Nursing qualification	-0.01	0.01
Experience years	.215**	-0.05
Patient age	0.03	-0.07
Patient education	-0.10	0.01
Patient income	-0.08	0.07
Number of diseases	.163*	-.172*
Number of medications	0.10	-.176*

(*) Statistically significant at p<0.05   (**) Statistically significant at p<0.01

Table 6: Best fitting multiple linear regression model for nurses' knowledge and practice scores

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Knowledge score							
Constant	71.74	7.63		9.40	<0.001	56.66	86.82
Age	0.51	0.13	0.295	3.98	<0.001	0.26	0.76
Female Gender	-11.59	3.55	-0.237	-3.27	<0.001	-18.59	-4.58
Training course in CHF	-6.31	2.60	-0.180	-2.43	0.020	-11.44	-1.19

r-square=0.17   Model ANOVA: F=12.09, p<0.001
Variables entered and excluded: qualification, experience, marital status, course in electrolyte balance

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
Practice score							
Constant	92.72	4.66		19.88	<0.001	83.51	101.93
Knowledge score	-0.21	0.07	-0.24	-3.15	<0.001	-0.34	-0.08
No. of medications	-1.54	0.54	-0.22	-2.84	0.010	-2.62	-0.47

r-square=0.10   Model ANOVA: F=9.96, p<0.001
Variables entered and excluded: age, qualification, experience, marital status, training courses, all patient socio-demographic and disease characteristics

References :
1. Ignatavicius D.D., and Workman M.L. : Medical-Surgical Nursing: Patient-Centered Collaborative care. 6th ed. St. Louis, MO: Elsevier ; 2010 . Pp170-198.
2. Goldman L. : Goldman's Cecil Medicine: Heart Failure (Ch 58, 59) 2th ed., Philadelphia: Elsevier Saunders; 2011. Pp 295–317.
3. Jessup M., Abraham W.T., and Casey D.E. : "2009 focused update: ACCF/AHA Guidelines for the Diagnosis and Management of Heart Failure in Adults: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines: developed in collaboration with the International Society for Heart and Lung Transplantation". Circulation. 2009; 119 (14): 1977–2016.
4. Porth C.M. : Essentials of Pathophysiology: Concepts of Altered Health States. 3rd ed., Philadelphia, PA: Lippincott Williams and Wilkins; 2011.
5. Huether S.E., and McCance K.L. : Understanding Pathology. 4th ed. St. Louis, MO: Mosby Elsevier; 2008. Pp. 99-120.
6. Chowdhury A.H., and Lobo D.N. : Fluids and gastrointestinal function. Curr Opin Clin Nutr Metab Care. 2011; 14.469-76.
7. Doherty M., and Buggy D.J.: Intraoperative fluids: how much is too much? ; Br J Anaesth. 2012; 109:69-79.
8. Kaplan L.J., and Kellum J.A. : Fluids, pH, ions and electrolytes. Curr Opin Crit Care. 2010; 16:323-31.

9. Lines S., and Lewington A. (2009): Acute kidney injury. Clin Med. 2009 ;9:273-7.

10. Perel P., and Roberts I. : Colloids versus crystalloids for fluid resuscitation in critically ill patients. Cochrane Database Syst Rev. 2011 ; (3):CD000567.

11. Lobo D.N., Stanga Z., and Aloysius M.M. : Effect of volume loading with 1 liter intravenous infusions of 0.9% saline, 4% succinylated gelatine (Gelofusine) and 6% hydroxyethyl starch (Voluven) on blood volume and endocrine responses: a randomized, three-way crossover study in healthy volunteers. Crit Care Med. 2010; 38:464-70.

12. Myburgh J.A., Finfer S., and Bellomo R. : the CHEST Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group. Hydroxyethyl starch or saline for fluid resuscitation in intensive care; N Engl J Med. 2012; 367:1901-11.

13. Persenius M.W., Hall-Lord M., Baath C., and Larsson B.W. : Assessment and Documentation of Patients Nutritional Status: Perception of Registered Nurses and their Chief Nurses ; Journal of Clinical Nursing. 2008 ; 17: 2125-2136.

14. Frangiosa A., De Santo L.S., Anastasio P., and De Santo N.G. : Acid-base balance in heart failure; J Nephrol.2006 ;19 Suppl 9:S115-20.

15. Stewart S. : Nurse-Led Care of Heart Failure: Will it Work in Remote Settings? Heart Lung Circ.2012.

16. Wunderlich R. : Principles in the selection of intravenous solutions replacement: sodium and water balance; J Infus Nurs.2013 ;36(2):126-30 .

17. Numminen O., Meretoja R., Isoaho H., and Leino-Kilpi H. : Professional competence of practising nurses; J Clin Nurs.2013 ;22(9-10):1411-23 .

18. Moceri J.T., and Drevdahl D.J. : Nurses' knowledge and attitudes toward pain in the emergency department; J Emerg Nurs.2014 ;40(1):6-12.

19. Godino L., Turchetti D., and Skirton H. : Knowledge of genetics and the role of the nurse in genetic health care: a survey of Italian nurses; J Adv Nurs.2013 ;69(5):1125-35 .

20. Limoges J., Acorn S., and Osborne M. : The scholarship of application: recognizing and promoting nurses' contribution to knowledge development; J Contin Educ Nurs.2015 ; 46(2):77- 82.

21. Ramoo V., Abdullah K.L., Tan P.S., Wong L.P., and Chua P.Y. : Intervention to improve intensive care nurses' knowledge of sedation assessment and management. Nurs Crit Care. 2014 Oct 1. doi: 10.1111/nicc.12105. [Epub ahead of print]

22. Mahendran R., Chua J., Peh C.X., Lim H.A., Ang E.N., Lim S.E., and Kua E.H. : Knowledge, attitudes, and practice behaviors (KAPb) of nurses and the effectiveness of a training program in psychosocial cancer care. Support Care Cancer.2014 ;22(8):2049-56.

23. Mahramus T.L., Penoyer D.A., Sole M.L., Wilson D., Chamberlain L., and Warrington W. : Clinical nurse specialist assessment of nurses' knowledge of heart failure. Clin Nurse Spec .2013 ;27(4):198-204 .

24. Maristany C.P., and Segurola Gurruchaga H. : [Hydration in clinical practice]. [Article in Spanish] Rev Enferm.2011; 34(1):59-64.

25. Numminen O., Laine T., Isoaho H., Hupli M., Leino-Kilpi H., and Meretoja R. : Do educational outcomes correspond with the requirements of nursing practice: educators' and managers' assessments of novice nurses' professional competence; Scand J Caring Sci. 2014 ;28(4):812-21.

26. Paul S., and Hice A. : Role of the acute care nurse in managing patients with heart failure using

evidence-based care. Crit Care Nurs Q.2014 ;37(4):357-76

27. Ayers C.J., Binder B.K., Lyon K.C., Montgomery D., Koci A., and Foster W.A. : The simulated hospital environment: a qualitative study applying space industry techniques; J Prof Nurs.2015 ;31(1):18-25.

28. Kothari N., and Ganguly B. (2014): Potential Drug - Drug Interactions

among Medications Prescribed to Hypertensive Patients; J Clin Diagn Res. 2014 ; 8(11):HC01-4.

29. Sehgal V., Bajwa S.J., Sehgal R., Bajaj A., Khaira U., and Kresse V. : Polypharmacy and potentially inappropriate medication use as the precipitating factor in readmissions to the hospital; J Family Med Prim Care.2013 ; 2(2):194-9 .