Effect of Hybrid Educational Program on Nurses' Performance regarding Caring of Patients with Fluid and Electrolytes Imbalance in Critical Care Units

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ABSTRACT

Background: Fluid balance monitoring is part of a nurse's scope of practice. Because fluid balance was calculated incorrectly, every patient management decision was influenced by incorrect fluid balance information. **Aim**: assess the effect of hybrid educational program on nurses' performance regarding caring of patients with fluid and electrolytes imbalance in Critical Care Units. **Design**: A quazi experimental design. **Setting**: The study was conducted at the critical care units at El Hussein university hospitals. **Subjects:** A purposive sample of (35) nurses. **Data collection tools:** Nurses' structured self- administered questionnaire and nurses' practices observational checklist. **Results:** the present study revealed that, more than half of the nurses had got unsatisfactory level of performance (knowledge & practice) regarding care of patients with fluid and electrolytes imbalance in critical care units at pre hybrid educational program implementation (57.10% and 54.30% respectively). Meanwhile, the majority of the study sample had got statistically significant improvement in their knowledge and practices regarding care of patients with fluid and electrolytes imbalance in critical care units at post hybrid educational program implementation (94.30% and 91.40% respectively). While this improvement lowered slightly post 3 months at follow up. **Conclusion** this study concluded that the hybrid educational program implementation for nurses' in the critical care unit was effective in improving their level of knowledge and practices regarding care of patients with fluid and electrolytes imbalance. **Recommendations:** Continuous evaluation of nurses' knowledge and practice is essential to identify their needs while caring for patients with fluid and electrolytes imbalance.

Keywords: Hybrid Education, Educational Program &Fluid and Electrolytes Imbalance

Introduction

The balance of fluids and electrolytes refers to the regulated partition of water between the cell and extracellular fluids of the body and the main chemical constituents. Electrolytes are the smallest chemicals that are essential for the function and activity of cells in the body. Electrolytes such as sodium, potassium and others are important in enabling cells to produce energy, preserve the integrity of their walls and function in general, electrolytes such as sodium, potassium and others are essential. They produce energy, contract muscles, move water and fluids inside the body and take part in countless other activities (Shrimanker & Bhattarai, 2020).

Fluid and electrolytes balance is an important daily activity in the intensive care unit. It's an important part of the care of patients daily. Fluid control and regulation of chronically ill patients is an important part of the continuum of treatment. Fluid and electrolyte imbalances must be rapidly detected because they can increase the likelihood of a future drop and can be life-threatening (Gagnon, et al., 2020).

Patients are hospitalized to the critical care unit because they are experiencing a physiological crisis

that is threatening one or more bodily systems as well as their lives. Fluid and electrolyte abnormalities are very common in critically ill patients. Fluid and electrolyte abnormalities in critical patients must be recognized and treated appropriately in more cases (Malbrain, et al., 2014).

Critical care nurses are essential in the care of critically ill patients. They should have the knowledge and clinical abilities needed to keep patients' hydration and electrolyte balance in check. They need to be well-trained in order to provide continuous monitoring and advanced care for a variety of urgent conditions. In the ICU, the nurse-to-patient ratio is usually one to two. As a result, critical care nurses can constantly monitor and detect changes in the patient's condition that require immediate management, such as fluid and electrolyte imbalances (AbdElalem and El Gahsh, 2018).

Many studies have been conducted in order to develop various nursing standards and protocols for providing optimal care to critically ill patients. Leilah ,(2019) Quite surprisingly, fluid and electrolyte disturbances in critically ill patients are still a common clinical relevance in intensive care units. Both at the national and international levels, this issue have received little attention. To the best of our knowledge, research on nursing practices for maintaining fluid and electrolyte balance in Egyptian intensive care units is scarce. As a result, the current study was carried out to investigate this area.

The goal of hybrid learning is to provide the most efficient and effective instruction experience by combining delivery modalities" As a result of the COVID-19 pandemic, educators have realized that a certain amount of flexibility is required both during the current situation and onward into the future. While hybrid learning has been emergency measure in the past, it may become mainstays of teaching and learning in the years to come (Gagnon, et al., 2020).

Significance of the study:

Fluid balance monitoring is part of a nurse's scope of practice. Because fluid balance was calculated incorrectly, every patient management decision was influenced by incorrect fluid balance information. As a result, nurses working in intensive care units (ICUs) are responsible and accountable for accurately recording and calculating fluid balance when caring for critically ill patients (Asfour, 2016).

Several ICU studies have suggested that fluid overload is associated with negative outcomes. It was discovered that at least one day of negative fluid balance is a predictor of survival in septic shock patients. Furthermore, studies found that a positive mean daily fluid balance was a significant predictor of mortality in the intensive care unit. A more positive fluid balance, on the other hand, is associated with an increased risk of mortality and discovered that mean ICU fluid balance was independently associated with an increased risk of ICU mortality (Bell, 2015).

Aim of the Study:

This study aims to assess the effect of hybrid educational program on nurses' performance regarding caring of patients with fluid and electrolytes imbalance in Critical Care Units through the following:

1- Assessment of nurses' level of performance (knowledge& practice) regarding caring of patients with fluid and electrolytes imbalance in critical care units.
2- Developing and implementing a hybrid educational program for nurses caring of patients with fluid and electrolytes imbalance in critical care units based on their needs.

3- Evaluating the effect of hybrid educational program on nurses' level of performance (knowledge & practices).

Research Hypothesis:

To achieve the aim of this study, it was hypothesized that the implementation of hybrid educational program regarding caring of patients with fluid and electrolytes imbalance in critical care units will lead to a significant positive improvement on nurses' level of performance (knowledge and practices).

Operational definition:

Hybrid educational program: A technology-dependent and organizationally driven instructional strategy that enables flexible face-to-face learning sessions for nurses, as well as synchronous and asynchronous remote access to program sessions.

Subjects and methods

Research design:

A Quasi-experimental research design was followed to achieve the aim of this study. An experiment is a study in which the researcher manipulates the level of some independent variable and then measures the outcome. Experiments are powerful techniques for evaluating cause-and-effect relationships. **Gopalan, Rosinger& Ahn, (2021)**

Setting:

The study was conducted at the critical care units (emergency care unit in the 2nd floor that consists of 5 rooms each room contains 4 beds, Medical care unit in the 7th floor that consists of 3 rooms one pig room contains 10 beds and the other two small rooms each one contains 4 beds & Neurological care unit that consists of 3 rooms each room contains 5 beds.) at El Hussein university hospital.

Subject:

A Purposive sample of (35) nurses were working in the previously mentioned critical care units at El Hussein university hospital, from both gender and different level of qualifications and met the inclusion criteria:

Inclusion criteria: staff nurses who are

- Willing to participate in the study
- Had smart phones linked with internet
- Ability to use Zoom and Telegram applications

Tools for data collection:

Tool 1: Nurses' Structured Self- Administered Questionnaire

It was developed by the researchers, written in simple Arabic language and filled by the study subjects.

This tool was divided into two parts as follows:

The first part included items about demographic characteristics of the studied nurses such as age, gender level of education, years of experience and training courses.

The second part included nurses' knowledge assessment questionnaire which used to assess their level of knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units. It was developed by the researcher after reviewing of the related literatures (Lynn, 2018 & Potter, 2017).

The questionnaire consisted of 40 questions in the form of multiple choice questions (MCQ) and included four items:-

(1) Normal values of fluid and electrolytes (10 questions)

(2) Causes of fluid and electrolytes imbalance (10 questions)

(3) Signs and symptoms of fluid and electrolytes imbalance (10 questions)

(4) Nursing care of patients with fluid and electrolytes imbalance (10 questions)

The total score of knowledge was equal 40 grades:

- o Each correct answer = one degree

- o Each incorrect answer = zero

- o Based on critical care approach it was considered that

- • >75% satisfactory level of knowledge (> 30 grades correct answer), <75% was unsatisfactory level of knowledge (< 30 grades correct answer).

Tool 2: Nurses ' observational checklists:

It was used to assess nurses' level of practices regarding caring of patients with fluid and electrolytes imbalance in critical care units. This tool was adopted from **Sole, klein & Moseley(2016), Melissa et al. (2013) and Patricia (2011) .**

This tool was included five procedures:

- Vital signs; "Axillary temperature measurement (22 steps), Respiration assessment (8 steps) & Blood pressure measurement (18 steps).

- Central venous measurement (22 steps).

- Intake and output measurement (22 steps).

- Venous blood sampling (32).

Scoring system:
The total score of practices was equal = 124

For correctly done step = one degree

For not done step or incorrectly done = zero.

The total score was distributed as the following:

- Vital signs; "Axillary temperature measurement (22), Respiration assessment (8), Blood pressure measurement (18)"

- Central venous pressure measurement (22)

- Intake and output measurement (22)

- Venous blood sampling (32)

Based on critical care approach, it was considered as follows:
>85%= competent level of practices (≥105 correct actions).

< 85% = incompetent level of practices (<105 correct actions).

Preparatory phase:

It included reviewing of literatures and theoretical knowledge of various aspects of the study using books, internet and articles. Periodicals and magazines to develop data collection tools.

B-Ethical Considerations:

The ethical research considerations in this study include the following:

1) Explain the aim of the study to the hospital director to apply this study for nurses included.

2) Explain the aim of the study to each nurse included in the study and take approval regarding participation in the study.

3) Assured that the obtained information will be confidential and used only for the purpose of the study.

4) The researchers approached the nurses individually at the critical care units at the El-Hussein University Hospital, explaining the purpose of the study and the importance of the hybrid educational protocol to improve their level

of performance regarding caring of patients with fluid and electrolyte imbalance in critical care units.

5) Nurses were informed that they allowed choosing to participate or not in the study and they had the right to withdraw from the study at any time without giving any reasons.

6) Confidently of all information was secured. The study tools could not cause any harmful effects on the subjects. Professional help was provided to all participants whenever needed.

C- Validity and reliability:

Testing validity

Validity refers to the fact that a tool measures exactly what it proposes to measure. Validity is not an instrument characteristic and must be determined regarding a specific matter (Da Silva, et al., 2015). A team of seven specialists from the Medical Surgical Nursing academic personnel assessed the proposed instruments. The tools were evaluated for clarity, relevance, comprehensiveness, simplicity, and application by the experts. Minor changes were made.

Testing reliability

The tool was tested to assure that it generates reliable and consistent results throughout time (Souza, Alexandre & Guirardello, 2017). The reliability coefficient for each research instrument was obtained using the correlation coefficient Cronbach's alpha test as follows: The Alpha Cronbach test for nurses' knowledge was 0.868, and the Alpha Cronbach test for nurses' practises was 0.752, indicating good reliability of employed instruments and statistical significance.

D-Pilot study:

A pilot study was carried out to assess the feasibility and application of the research instruments employed in this study. It was performed on 10% of the total research subjects. There were no changes made, thus nurses who participated in the pilot trial were included in the main study group.

Field work:

- The fieldwork was done though assessment, planning, implementation, and evaluation phases that extended over a period of one year from January 2019 to January 2020.

Assessment phase

- The tools were developed by the researchers based on reviewing the recent and related literature.

- The researchers visit the study settings for two days weekly. The researchers filled the nurses' observational checklists in the morning and afternoon shifts during actual nurses' work and documentation for steps of patients` care in critical care unit.

- The nurses' observational checklists were used prior to administration of questionnaire to ensure the maximal realistic observations of the nurses' performance and minimize bias possibility.

- Each nurse was observed by the researchers during the performance as regards: measurement of vital signs (measurement of axillary temperature, respiration and blood pressure), venous blood sampling, CVP, intake and output and venous blood sampling. It took about 30- 45 minutes for all procedures.

- The self-administered questionnaire sheet as regards nurses' knowledge about fluid and electrolytes imbalance in Google form link and

send to the nurses through telegram group. It took about 30-35 minutes.

Planning phase

- During this phase, the researchers explained to nurses the benefits of hybrid educational protocol as the availability of the educational protocol contents with the nurses, continual communication with the researchers through a telegram group and providing feedback about the hybrid educational protocol effectiveness as well as providing their suggestions for the improvement of the hybrid educational protocol .

- The researchers obtained telephone number from each nurse and assessed the availability of internet access to communicate with the researchers via Telegram group and Zoom meeting.

- A telegram group was developed by the researchers to communicate with nurses and to present the content of the hybrid educational program (Booklet, videos, procedures, porchures and lectures).

- A simple booklet educational program was designed by the researchers, based on the results obtained from the assessment phase. The content of booklet was written in simple Arabic language and consistent with the related literature (Brown, et al., 2017 & Lynn, 2018). It was designed to improve nurse's knowledge and practice regarding caring of patients with fluid and electrolytes imbalance in critical care units. The content of the educational program covered two parts related to data collection tools.

- Knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units: Includes normal values of fluid and electrolytes, causes of fluid and electrolytes imbalance, signs and symptoms of fluid and electrolytes imbalance and nursing care of patients with fluid and electrolytes imbalance

- Practices regarding assessment of fluid and electrolytes imbalance: Vital signs (Axillary temperature measurement, respiration assessment, blood pressure measurement), central venous measurement , intake and output measurement and venous blood sampling.

Implementation phase

- After completion of the educational program development, the theoretical part was divided into four parts to upload each part weekly to the telegram group for one month.

- Educational sessions (practical part) were scheduled with the nurses according to their circumstances which carried out face to face in the intensive care unit.

- Nurses were divided into seven groups each group consists of 5 nurses, considering time table according to their circumstances.

- The researchers determined one day weekly to upload educational contents of each part of the hybrid educational program and implement a zoom meeting session; as well nurses were informed to join this meeting on time to allow for open discussion between all the group members.

- Different teaching strategies were used including instructions, lectures, brainstorming, group discussion, clinical teaching and demonstration videos. The teaching aids used were handouts, colored posters and laptop screen show.

- Each nurse of all studied groups obtained a copy of the hybrid educational program in Arabic language booklet included all theoretical and practical content.

- An open channel communication was achieved between researchers and nurses to ensure understanding, answer any question and to verify information and practical skills given.

Evaluation phase

- At the end of hybrid educational program implementation evaluation was done to assess nurses' knowledge and practice regarding caring of patients with fluid and electrolytes imbalance in critical care units by using the same data collection tools and techniques to evaluate the effectiveness of hybrid educational program immediately post implementation and follow up after three months later.

Statistical Design

Data were collected, revised, coded, analyzed, and tabulated using number and percentage distribution. Variables were compared using chi-square test and correlation study (r). The variables were significant(S) at P- value < 0.05, highly significant (HS) if $p < 0.01$ and non-significant (NS) if $p > 0.05$. All the statistical analyses were performed using Statistical Package for Social Sciences (SPSS), version 20.

Results

Table (1): Number and percentage distribution of demographic characteristics among studied nurses (n=35)

Items	No.	%
Gender		
Male	9	25.7
Female	26	74.3
Age(years)		
18 - < 29 yrs	17	48.6
29 - < 39 yrs	18	51.4
Education		
Diploma nursing	14	40.0
Nursing institute	14	40.0
Bachelor degree in nursing	7	20.0
Experience (years)		
1-< 5 yrs	7	20.0
5-<10 yrs	12	34.3
10 – or more	16	45.7
Training courses		
Yes	0	0
No	35	100

Table (2): Comparison between total level of nurses' knowledge regarding fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation (n =35)

Items	Pre Satisfactory	Pre Unsatisfactory	Post Satisfactory	Post Unsatisfactory	Follow up Satisfactory	Follow up Unsatisfactory	ANOVA test	P-value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
Normal values of fluid and electrolytes.	7 (20.0)	28 (80.0)	31 (88.5)	4 (11.4)	28 (80)	7 (20.0)	13.007	<0.01**
Causes of fluid and electrolytes imbalance	15 (42.8)	20 (57.1)	32 (91.4)	3 (8.5)	30 (85.7)	5 (14.2)	11.208	<0.01**
Signs and symptoms of fluid and electrolytes imbalance	21 (60.0)	14 (40.0)	33 (94.2)	2 (5.7)	31 (88.5)	4 (11.4)	14.913	<0.01**
Total	11 (31.4)	24 (68.6)	32 (91.4)	3 (8.6)	30 (85.7)	5 (14.3)	16.228	<0.01**

*significant <0.05 **Highly significant <0.01

Table (3): Differences between level of nurses' knowledge regarding nursing care for patients with fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation (n=35)

Items	Pre Satisfactory	Pre Unsatisfactory	Post Satisfactory	Post Unsatisfactory	Follow up Satisfactory	Follow up Unsatisfactory	ANOVA test	P-value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
Assessment of fluid deficit	27 (77.1)	8 (22.8)	35 (100)	0 (0.0)	34 (97.1)	1 (2.8)	14.668	<0.01**
Assessment of intravenous solution rate	15 (42.8)	20 (57.1)	33 (94.2)	2 (5.7)	31 (88.5)	4 (11.4)	15.604	<0.01**
Assessment of edema	29 (82.8)	6 (17.1)	35 (100)	0 (0.0)	35 (100)	0 (0.0)	13.999	<0.01**
Patients with fluid volume excess	29 (82.8)	6 (17.1)	35 (100)	0 (0.0)	35 (100)	0 (0.0)	12.374	<0.01**
Patient taking Lasix	23 (65.7)	12 (34.2)	33 (94.2)	2 (5.7)	31 (88.5)	4 (11.4)	14.228	<0.01**
Patient with hypernatremia	26 (74.2)	9 (25.7)	32 (91.4)	3 (8.5)	32 (91.4)	3 (8.5)	13.245	<0.01**
Precautions during blood sample for potassium test	18 (51.4)	17 (48.5)	32 (91.4)	3 (8.5)	31 (88.5)	4 (11.4)	9.163	<0.01**
Signs of hypokalemia	20 (57.1)	15 (42.8)	30 (85.7)	5 (14.2)	29 (82.8)	6 (17.1)	9.886	<0.01**
Dilution of 10 mmol of intravenous potassium	23 (65.7)	12 (34.2)	33 (94.2)	2 (5.7)	32 (91.4)	3 (8.5)	10.417	<0.01**
Precautions on administration of intravenous potassium	22 (62.8)	13 (37.1)	33 (94.2)	2 (5.7)	31 (88.5)	4 (11.4)	10.611	<0.01**
Total	20 (57.1)	15 (42.9)	34 (97.1)	1 (2.9)	32 (91.4)	3 (8.6)	19.568	<0.01**

*significant <0.05 **Highly significant <0.01
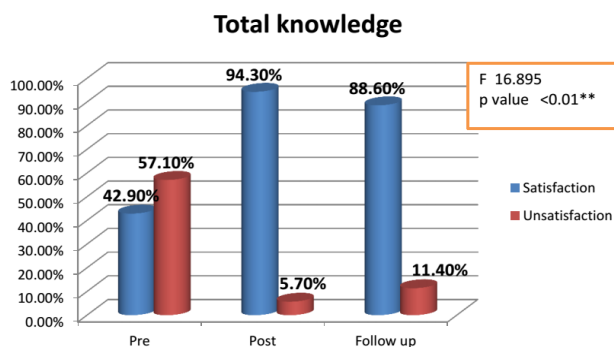
Total knowledge

F 16.895
p value <0.01**

Figure (1) Distribution of total level of nurses' knowledge regarding fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation (n=35)

Table (4): Differences between total level of nurses' practices regarding care of patients with fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation (Vital signs measurement) (n= 35)

	Pre		Post		Follow up		ANOVA test
	Competent	Incompetent	Competent	Incompetent	Competent	Incompetent	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
Axillary temperature measurement	14 (40)	21 (60)	32 (91.4)	3 (8.5)	30 (85.7)	5 (14.2)	10.484 <0.01**
Respiration measurement	18 (51.4)	17 (48.5)	33 (94.2)	2 (5.7)	31 (88.5)	4 (11.4)	11.675 <0.01**
Blood pressure measurement	20 (57.1)	15 (42.8)	34 (97.1)	1 (2.8)	32 (91.4)	3 (8.5)	9.163 <0.01**
Central venous pressure measurement	13 (37.1)	22 (62.8)	31 (88.5)	4 (11.4)	29 (82.8)	6 (17.1)	12.005 <0.01**
Intake and output measurement	15 (42.8)	20 (57.1)	32 (91.4)	3 (8.5)	30 (85.7)	5 (14.2)	13.462 <0.01**
venous blood sampling	18 (51.4)	17 (48.5)	34 (97.1)	1 (2.8)	31 (88.5)	4 (11.4)	10.901 <0.01**

*significant <0.05 **highly significant <0.01

Total Practice
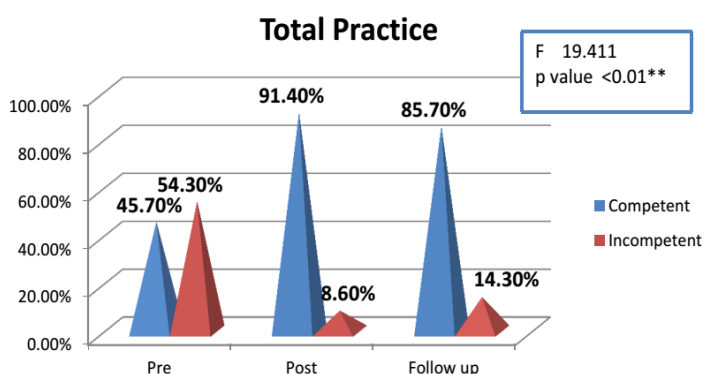

F 19.411
p value <0.01**

Figure (2) Percentage distribution of total level of nurses' practice regarding care of patients with fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation (n=35)

Table (5): Relation between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units and their demographic characteristics (n=35).

Items	Satisfactory (n=15)		Unsatisfactory (n=20)		Chi Square	P Value
	No	%	No	%		
Gender						
- Males	6	40	3	15	2.141	0.062
- Female	9	60	17	85		
Age						
- 18<29	7	46.7	10	50	3.010	0.059
- 29<39	8	53.3	10	50		
Education Level						
- Nursing Diploma	1	6.7	13	65		
- Nursing Institute	8	53.3	6	30	12.788	0.009**
- Bachelor Degree in nursing	6	40	1	5		
Years of Experience						
- Less than 5 Years	0	0	7	35		
- 5 - < 10	4	26.7	8	40	14.506	0.002**
- Ten or more years	11	73.3	5	25		

*P ≤ 0.05 Significant, **P ≤ 0.01 High Significant

Table (6): Relation between total level of nurses' practice regarding caring of patients with fluid and electrolytes imbalance in critical care units and their demographic characteristics (n=35).

Items	Competent (n=16)		Incompetent (n=19)		Chi Square	P Value
	No	%	No	%		
Gender						
- Males	5	31.3	4	21.1	1.662	0.074
- Female	11	68.7	15	78.9		
Age						
- 18<29	6	37.5	11	57.9	6.514	0.038*
- 29<39	10	62.5	8	42.1		
Education Level						
- Nursing Diploma	1	6.3	13	68.4		
- Nursing Institute	8	50	6	31.6	16.077	0.001**
- Bachelor Degree in nursing	7	42.7	0	0		
Years of Experience						
- Less than 5 Years	1	6.3	6	31.6		
- 5 - < 10	3	18.7	9	47.3	14.897	0.003**
- Ten or more years	12	75	4	21.1		

*significant <0.05 **Highly significant <0.01

Table (7): Correlation between total studied nurses` knowledge and practices regarding caring of patients with fluid and electrolytes imbalance in critical care units. (n=35)

Items	Total practices	
	R	p- value
Total knowledge	0.784	0.001**

*significant <0.05 **highly significant <0.01

Table (1) showed that (74.3%) of the studied nurses were female and (51.4) of them their age was 29 - < 39 years. Regarding to education, (40.0%) of them had diploma nursing and nursing institute, respectively. Also, (45.7%) of them their experience was 10- or more. Moreover, (100%) of them not attended training courses.

Table (2) revealed that, there was highly statistically significant difference between total level of nurses' knowledge regarding fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation at (P= < 0.01).

Table (3) reported that there was highly statistically significant difference between satisfactory level of nurses' knowledge regarding nursing care for patients with fluid and electrolytes imbalance in critical care units at pre, post and follow up phases of hybrid educational program implementation related to all points at p value <0.01.

Figure (1) demonstrated that, (57.10%) of the studied nurses had unsatisfactory knowledge about fluid and electrolytes imbalance in critical care units at pre hybrid educational program implementation. While, (94.30% & 88.60%) of them had satisfactory level of knowledge about fluid and electrolytes imbalance in critical care units at post and follow up phases of hybrid educational program implementation, respectively.

Table (4) presented that, there was highly statistically significant difference between competent level of practices at pre, post and follow up phases of the of hybrid educational program implementation related to all procedures regarding care of patients with fluid and electrolytes imbalance in critical care units at p value <0.01.

Figure (2) showed that, (54.30%) of the studied nurses had incompetent level of practice regarding care of patients with fluid and electrolytes imbalance in critical care units at pre hybrid educational program implementation. While, (91.40% & 85.70%) of them had competent level of practice regarding care of patients with fluid and electrolytes imbalance in critical care units at post and follow up phases of hybrid educational program implementation, respectively.

Table (5) revealed that, there were highly statistically significant relation between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care unit, their education level and years of experience at (P= < 0.01). While, there were statistically insignificant relation with gender and age at (p= > 0.05).

Table (6) illustrated that, there were highly statistically significant relation between total level of nurses' practices regarding caring of patients with fluid and electrolytes imbalance in critical care units and their education level and years of experience at (P= < 0.01). Also, there was statistically significant relation with their age at (p= < 0.05). While, there was statistically insignificant relation with gender at (p= > 0.05).

Table (7) demonstrated that, there was a positive correlation between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units and their total level of practices at (p= .001).

Discussion

Critically ill patients have a wide range of illnesses, but many have electrolyte abnormalities or fluid imbalances that can threaten their clinical condition and negatively impact outcomes. The "critical care shuffle" of electrolytes and fluids can be attributed to an underlying chronic disease state, an

acute illness that emerges during the patient's hospitalization, or the use of particular drugs. Monitoring and controlling electrolytes and fluid balance is an essential element of assessing and caring for a critically ill patient (Culleiton, & Simko, 2012)

Regarding the study nurses' characteristics, the results of the present study revealed that about three quarter of the studied nurses were female. This result was highly supported by Mohamed ,Mohamed and Taha, (2019) in their study titled ''effect of educational protocol regarding accurate monitoring fluid balance on critical care nurses' knowledge and practice'' they discovered that women made up more than half of the whole study group. These findings may be explained by the fact that nursing is a universally feminine vocation, particularly in Egyptian society and culture, and that enrollment of male students in this profession began in the late decades. These findings also agreed with Aslam et al., (2017) they conducted a study on critical care nurses titled ''the assessment of nurses' knowledge and practices about fluid and electrolytes monitoring and administration among cardiac surgery patients: a case of punjab institute of cardiology", They reported that all of the nurses in the trial were females.

Regarding age more than half of the nurses at the age of 29 - < 39 years. This result is in accordance with Sheta and Mahmoud, (2018), who mentioned in their study about ''effectiveness of structured educational program on knowledge and practice among nurses regarding body fluid balance assessment for critically ill patients" that more than half of nurses between the ages of 25 and 30. As well, in a study by AbdElalem and El Gahsh, (2018) titled " effect of an instruction intervention about body fluid balance assessment on knowledge and practice among nurses in intensive care unit" They discovered that more than

half of the studied nurses were between the ages of 25 and 35.

Concerning educational level the present study findings demonstrated that, two fifth of nurses had diploma nursing and nursing institute. This study results is similar to the study done by Eldsouky, Taha and Saleh, (2016) who mentioned in their study about '' nurses' knowledge and practice concerning fluid and electrolyte balance among patients with congestive heart failure '' that about half of the sample held a nursing technical institute of nursing education degree. This result was contradicting with Malekzadeh, Mazluom, Etezadi, and Tasseri, (2013) in their study, ''A standardized shift handover protocol: Improving nurses' safe practice in intensive care units" They discovered that the majority of participants had a baccalaureate degree in nursing.

Regarding years of experience findings of the present study showed that near to half of the nurses had 10 or more years of experience in working at critical care units. This result contradicted with Abd Elalem and El Gahsh, (2018) they indicated that around one-third of the tested sample had at least ten years of experience. Concerning training courses this study displayed that the majority of the study sample had not attended training courses. This may be due to lack of courses and educational programs in educational training unit in the hospital. Results validated by Sheta and Mahmoud, (2018), they concluded that the majority of the nurses studied had not previously participated in any training program. This finding is contradicted by Ruth and Mogileeswari, (2016) their study titled "assess knowledge and practice regarding fluid and electrolyte replacement therapy for patient with burns" found that fewer than quarter of nurses did not obtain training.

The finding of the current study revealed that the majority of the studied nurses had an unsatisfactory score of knowledge regarding fluid and electrolytes imbalance in critical care units at pre hybrid educational program implementation. These results may be explained that they haven't attended any previous training regarding fluid and electrolytes imbalance and the satisfactory score improved post its implementation, while this improvement lowered slightly in the follow-up phase.

This could be attributed to the effectiveness of conducting the hybrid educational program. This finding was in the same line with Awad, Mohamed and Hamed, (2020), who examined the "effect of an educational program on nurse's performance regard monitoring fluid and electrolyte replacement for burned patients" and reveal that there is a significant difference in nurses' knowledge of fluids and electrolytes balance for burn patients and nursing care for electrolyte imbalance before and after the program. These results match with the results of the study done by Mohamed ,Mohamed and Taha ,(2019), They discovered that the majority of the research group had a high degree of knowledge of fluid balance evaluation post-educational program compared to pre-educational program.. This result in the same line with Kol, İlaslan, and Turkay, (2017) who "assess the training needs of clinical nurses at an university hospital in Turkey" stated that ongoing nursing education is a critical issue that assists professional nurses in staying current with nursing science, hence improving nursing practices.

As regards level of nurses' knowledge regarding nursing care for patients with fluid and electrolytes imbalance there was highly statistically significant difference between satisfactory level of nurses' knowledge regarding nursing care for patients with fluid and electrolytes imbalance in critical care units at

pre, post and follow up phases of hybrid educational program implementation related to all points. This agreed with Sheta and Mahmoud, (2018) they concluded that there were high significant changes between pre and post-program implementation in terms of overall mean score of nurses' practices for assessing fluid input for critically sick patients for all fluid input categories. These results were also validated by Eldsouky et al., (2016) they concluded that minority of the participants were nurses doing admission measures such as vital sign checks. Also, Johnson, (2016) found a difference between fluids provided and fluids noted in the patient chart. On the other hand, these results were not consistent with the study conducted by Vincent et al., (2015) they concluded that a fluid balance monitoring audit was performed on 117 patients and revealed that less than half of the fluid balance charts had been completed due to insufficient documentation of fluid intake.

Findings of the study showed that, more than half of the studied nurses had incompetent level of practice regarding care of patients with fluid and electrolytes imbalance in critical care units at pre hybrid educational program implementation. While, the majority of them had competent level of practice regarding care of patients with fluid and electrolytes imbalance in critical care units at post and follow up phases of hybrid educational program implementation. These results match with the results of Sheta and Mahmoud, (2018) they discovered that after program implementation, total practices scores improved considerably. Also, Diacon and Bell ,(2014) who "Investigating the recording and accuracy of fluid balance monitoring in critically ill patients" and showed that, following a body fluid monitoring education program, nurses' practices regarding fluid

and electrolyte balance improved in patients with congestive heart failure.

Also these results agree with Kol et al., (2017) they determined that a continual in-service training program for nurses is a very significant concern because it helps professional nurses learn about new developments in nursing science, which improves nursing practices. Leilah, Kandeel, Shebl, and Mansour,(2019) in their study titled ''developing nursing standards for maintaining fluid and electrolyte balance for critically ill patients in intensive care units'' their results revealed that only one-third of nurses were capable of monitoring and recording fluid intake and output. These findings were attributed to a lack of information and training for nurses in measuring and recoding fluid balance. This was emphasized by Asfour, (2016) a study titled ''fluid balance monitoring accuracy in intensive care units'' which revealed that because nurses attended continuing education seminars on maintaining and recording fluid balance, more than two-thirds of the recorded fluid balance chart was accurate and comprehensive. Also, The study done by Mohammed, Elshamy and Mohammed, (2015) in their study titled ''effect of implementing intravenous infusion therapy protocol on nurses' knowledge and performance at specialized medical hospital'' revealed that the overall mean knowledge and performance score of nurses improved immediately after the protocol's introduction with a statistically significant difference and then slightly declined after one month. As a result of the study's findings, nurses must follow the procedure for fluid and electrolyte imbalance.

Regarding relation between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units and their demographic characteristics this study revealed that, there were highly statistically significant relation

between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care unit and their education level and years of experience. While, there were statistically insignificant relation with gender and age, this finding coherent with the study done by Trikhatri , Rana and Angadi, (2019) they studied "knowledge and Practice regarding fluid and electrolytes administration among nurses working in a teaching hospital" and indicated that there was a strong statistically significant relationship between degree of knowledge and level of education. This finding agree with study done by Mohammed and Taha , (2014) who reported that bachelor's degree nurses performed much better than diploma nurses. This could be due to the basic knowledge acquired during academic years differs from that acquired by diploma nurses.

Concerning relation between total level of nurses' practice regarding caring of patients with fluid and electrolytes imbalance in critical care units and their demographic characteristics, this study illustrated that, there were highly statistically significant relation between total level of nurses' practice regarding caring of patients with fluid and electrolytes imbalance in critical care units and their age, education level and years of experience. This study adheres with the study conducted by Mogileeswari and Ruth ,(2016) they signified that there is a substantial relationship between nurses' degree of practices in terms of fluid and electrolyte delivery for patients with burns and their year of experience and designation. In contrast with Trikhatri , Rana and Angadi,(2019) showed that level of nurses' practice was strongly correlated with current working area but not with age, education, experience, other characteristics of nurses, or health care environment related factors.

As regard Correlation between total studied nurses' knowledge and practices regarding caring of patients with fluid and electrolytes imbalance in critical care units the study demonstrated that, there was a positive correlation between total level of nurses' knowledge regarding caring of patients with fluid and electrolytes imbalance in critical care units and their total level of practices. This result inconsistent with Mohamed ,Mohamed and Taha , (2019), who revealed that there was no statistical significance relation between the overall knowledge score at the pre and post educational protocol and the total practice score at the pre and post educational protocol. (one month & three months) .

In contrast with the study done by Trikhatri , Rana and Angadi, (2019) who reported that there is a small positive association between nurses' knowledge and practice, although it is not statistically significant. The reason for the results study is due to the fact that fluid and electrolytes practice may be completed without comprehending the basic information, by repetitive action and seeing the same method over and over again.

The correlation between nurse's knowledge and practice score in the study however, point out truth that the effective nurses' performance regarding fluid and electrolytes imbalance is often hindered by lack of basic knowledge.

This result supported by the study done by Ameri et al. , (2016) they concluded that after a parenteral nutrition training program, the mean scores of knowledge and practice increased. Therefore, the findings of this study are a good basis to formulate the educational activities, as there is need of educational program regarding fluid and electrolytes administration. Improving knowledge and monitoring nurse's practices could significantly reduce the complication that may develop from the fluid and electrolytes imbalance.

Conclusion

Based on the findings of the present study, it can be concluded that: This study concluded that the hybrid educational program implementation for nurses' in the critical care unit was effective in improving level of nurses' knowledge and practices regarding caring of patients with fluid and electrolytes imbalance .

Recommendations

- Continuous evaluation of nurses' knowledge and practice is essential to identify their needs while caring for patients with fluid and electrolytes imbalance in the critical care unit.

- Continuous training courses should be implemented for nurses in critical care units to update their knowledge and practice regarding caring of patients with fluid and electrolytes imbalance.

- Implementing the hybrid educational program on a wider field including all governmental hospitals is necessary to raise the efficiency of nursing care for patients with fluid and electrolytes imbalance.

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