



Developing nursing standard for maintaining fluid and electrolyte balance for critically ill children at pediatric intensive care unit

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Abstract

Background: Fluid and electrolyte disturbances are the most frequently reported problems in PICUs; which are associated with high morbidity and mortality rate among critically ill children. This study aimed to develop nursing standard for maintaining fluid and electrolyte balance for critically ill children at Pediatric Intensive Care Unit.

Method: An exploratory descriptive design was implemented at PICU in Assiut University Children Hospital. A convenience sample of all PICU nurses were involved in this study. Two tools were used to collect the study data:

Tool (1): A structured interview questionnaire for nurses. It consisted of two parts; characteristics of the studied nurses and nursing competencies for fluid and electrolyte standard questionnaire.

Tool (2): Nursing standards for maintaining fluid and electrolyte balance observation checklist. The study results indicated that 78.8% of the nurses had a satisfactory knowledge level. Also, 87.9% had unsatisfactory practice in the first assessment which declined to 48.5% in the second assessment ($p= 0.001^{**}$). It was concluded from the study results that more than three-quarters of the nurses had a satisfactory knowledge level. Also, the majority of the nurses had unsatisfactory practice in the first assessment which improved in the second assessment with a statistically significant difference.

Keywords: critically ill children, developing nursing standard, maintaining fluid and electrolyte balance, pediatric intensive care unit

Introduction

Monitoring fluid balance in a pediatric intensive care unit (PICU) is vital to assess fluid overload, which can deleteriously affect the patients' outcomes (Flori *et al.*, 2011 and Sutherland *et al.*, 2010) [15, 32]. Also, electrolyte imbalances are common in critically ill pediatric patients (Octavia *et al.*, 2020 and Cited by Naseem *et al.*, 2019) [30, 29]. Furthermore, if present can significantly affect the outcome of patients and are associated with increased morbidity and mortality rates (Hu *et al.*, 2017 and Balci *et al.*, 2011) [20, 6]. Abnormal serum electrolytes may provide clues to the diagnosis, severity, and even prognosis of illnesses (Arachchige & McClure, 2020) [3]. Critical care provision through pediatric intensive care units (PICUs) is aimed at maintaining homeostasis in the body which is vital for the organ's support and optimal function. This involves not only fluids but also electrolyte balance (Balci *et al.*, 2011) [6].

There are five potential factors for the occurrence of electrolyte imbalance as; the causative disease process, end-organ injury, fluid and electrolyte interventions, use of medications with the possible of electrolyte imbalances, and

application of critical care technology i.e. positive pressure ventilation (Hauser and Kulick, 2014 Cited by Naseem *et al.*, 2019) [19, 29]. Another causing factor is nurses' practice errors, such as inappropriate administration of fluid and electrolytes, and medication administration errors (Buckley, 2012 Cited by Leilah *et al.*, 2019) [9, 24]. These factors are interfering with body's absorption of electrolytes and having a negative impact on the function of body organs that responsible for maintaining fluid and electrolyte balance (Besen *et al.*, 2015 Cited by Leilah *et al.*, 2019) [8, 24].

Critical care PICU nurses play a vital role in caring for critically ill children and should have the knowledge and clinical skills required for optimal maintenance of patients' hydration status and electrolyte balance (Timby & Smith, 2013) [33]. Also, the nurses should have critical thinking and advanced problem-solving skills and practice-based upon evidence-based research in order to provide high-quality patient care (Bell, 2015) [7].

Nursing care should be guided by clearly defined standards to ensure a high quality of care. Standards of care are authoritative statements that describe a common or acceptable level of patient care or performance (Ibrahim *et*

al., 2017) [21]. Many studies were conducted to develop various nursing standards for optimal care delivery for critically ill patients (Aboud, 2011) [1]. There is a lot of published adult data addressing this problem but pediatric data has just begun to generate especially over the last decade with the growth of pediatric critical care medicine subspecialty. This study was conducted to develop nursing standards for maintaining fluid and electrolyte balance for critically ill children at the PICUs.

1.1 Aim of the study

This study aimed to develop nursing standard for maintaining fluid and electrolyte balance for critically ill children at Pediatric Intensive Care Unit.

1.2 Research question

Do the PICU nurses have a satisfactory level of knowledge and practice regarding fluid and electrolyte balance for critically ill children?

2. Materials and Method

2.1 Study design

An exploratory descriptive design was implemented for this study.

2.2 Setting of the study

This study was carried out at PICU in Assiut University Children Hospital. It includes 35 beds, about 20 cases admitted in the month. It gives care to critical cases of children as: Neurological problems e.g. meningitis, encephalitis, and Guillain-Barre syndrome, respiratory problems e.g. acute respiratory distress syndrome, tuberculosis, and pneumonia, gastrointestinal problems e.g. complicated gastroenteritis cases, and emergency complicated cases e.g. poisoning and inhalation of a foreign body.

2.3 Study subjects

A convenience sample of all PICU nurses was involved in this study. They were thirty-three nurses; twelve of them had graduated from the secondary school of nursing, seven had graduated from the technical institute of nursing, five had graduated from the health technical institute of nursing, and nine had a bachelor's degree in nursing.

2.4 Tools of the study

Two tools were used to collect the data for this study:

2.4.1 Tool (1): A structured interview questionnaire for nurses. It consisted of two parts.

Part one: It was involved characteristics of the studied nurses such as; age, educational level, years of experience in the PICU, and attending training courses concerning fluid and electrolyte balance.

Part two: Nursing competencies for fluid and electrolyte standard questionnaire: It was developed by the researchers based on relevant previous literature by Leilah *et al.*, (2019) [24], Al-Kareem, (2014) [2], Aboud, (2011) [1], Donabedian, (1989) [13]. It was aimed to assess the nurses' opinions regarding nursing competencies required for maintaining fluid and electrolyte balance for critically ill

children in PICU. It was included 11 items; the basic nursing assessment measures and all nurses' responsibilities concerning maintaining fluid and electrolyte (e.g. sodium, potassium, and calcium) balance for critically ill children.

Scoring system: The nurses' answers were recorded based on a Likert scale composed of a four-point (1="disagree", 2="somewhat agree", 3="agree", 4="strongly agree"). The total score was considered satisfactory if agree level $\geq 60\%$; while a score $<60\%$ was considered unsatisfactory (Leilah *et al.*, 2019) [24].

2.4.2 Tool (2): Nursing standards for maintaining fluid and electrolyte balance observation checklist. It was adapted from the previous related researches by Leilah *et al.*, (2019) [24], Eldoseky (2012) [14] and Mahani (2011) [25]. It was an observational checklist aimed to assess the competency level of PICU nurses for maintaining fluid and electrolyte balance also, fluid and electrolyte imbalance management. It was involved 11 items; which incorporates procedures and actions regarding management of fluid and electrolyte disturbances e.g. fluid parameters measurement, signs and symptoms indicating for fluid disturbance, and nursing interventions towards maintaining fluid balance.

Scoring system: During the nurses' observation; items which observed done completely scored "2", the items observed done incompletely scored "1", while the items observed not done scored "0". The total score of practice was considered satisfactory if $\geq 75\%$, while a score $<75\%$ was considered unsatisfactory practice (Leilah *et al.*, 2019) [24].

2.5 Method of Data collection:

2.5.1 Official permission was obtained from the Chairmen of PICU in Assiut University Children Hospital to collect the data after clarifying the aim of study.

2.5.2 The content validity of the tools (one and two) was assessed by five professors in the field of Pediatric Nursing. The content validity index for tool one was 0.85 and 0.83 for tool two. Also, the reliability was assessed by using Cronbach's α test to measure the internal consistency. It was $R=0.86$ for tool one and $R=0.84$ for tool two.

2.5.3 Ethical approval was achieved from the Ethical Committee at the Faculty of Nursing in Assiut University. The purpose and nature of the study were clarified to the PICU's nurses. Also, the nurses informed that they had the right to participate or not in the study. Written consent was gotten for participation in the study. The nurses were informed that the gained information would be confidential and used only for the purpose of the study.

2.5.4 A pilot study was done for three nurses (10%) to test the clarity and applicability of the study tools and to estimate the time needed for filling the questionnaire. Based on the results of the pilot study no modifications were done to the tools. The nurses in the pilot study were included in the total sample.

2.5.5 Field of the work

The data collection was starting from October 2019 to the end of December 2019. The researchers interviewed the nurses individually at PICU, then introduced themselves and explained the purpose and nature of the study. The researchers interviewed the nurses on the morning shift, during the working time. Three sessions were applied for each nurse: In the first session; the researchers filled the interview questionnaire (tool one). In the second and third sessions; the researchers observed the nurses during the practice (children's care) using tool two (an indirect observational checklist) to observe the nurses' practices for maintaining the fluid balance of critically ill children in the first and second assessments. The researchers interviewed two or three nurses one day/week. The duration of each

session was variable and ranged between 45-60 minutes.

2.6 Statistical Analysis

Data were coded and entered by using the Statistical Package for Social Science (SPSS) version 20. Data analysis was done in the form of univariate analysis: descriptive statistics (frequency & percent for qualitative data, mean ± SD for quantitative data). Bivariate analysis: cross-tabulation. Chi-square test (X²) and t-test were used to test the difference between the proportions of qualitative data. The statistical significance level was considered when the p-value ≤ 0.05 for all statistical tests.

3. Results

Table 1: Characteristics of the studied nurses (n=33):

Characteristics	No	%
Age/ years		
• Less than 25	13	39.4
• From 25-30	13	39.4
• More than 30	7	21.2
Mean ± SD (range)	27.27 ± 3.54 (22-34)	
Education Level		
• Secondary School of Nursing	12	36.4
• Technical Institute of Nursing	7	21.2
• Health Technical Institute of Nursing	5	15.1
• Bachelor's Degree in Nursing	9	27.3
Years of experience in PICU		
• Less than 5 years	20	60.6
• From 5-10 years	4	12.1
• More than 10 years	9	27.3
Mean ± SD (range)	6.85 ± 5.76 (1-18)	
Attending training courses concerning fluid and electrolyte balance for critically ill children:		
• Yes	11	33.3
• No	22	66.7

Table (1): Illustrates the characteristics of the studied nurses. It was showed that 39.4 % of the PICU nurses were in the age group less than 25 and from 25-30 years with a mean age of 27.27 ± 3.54. Also, 36.4% of them graduated from secondary school of nursing. As regards the years of

experience; it was found that less than two-thirds of the nurses (60.6%) had less than 5 years. Moreover, 33.3 % of them had attended training programs concerning fluid and electrolyte balance for critically ill children in PICU.

Table 2: Nurses' opinions concerning assessment methods required for fluid and electrolyte nursing standard (n=33):

Basic Competencies	Disagree		Agree to some extent		Agree		Strongly agree	
	No	%	No	%	No	%	No	%
• Measure CVP/ 6 hour (for fluid and sodium disorder)	1	3.0	10	30.3	9	27.3	13	39.4
• Measure fluid intake and output /hour (for fluid, sodium, potassium disorder)	5	15.2	9	27.3	11	33.3	8	24.2
• Assess changes in body weight daily	0	0.0	3	9.1	14	42.4	16	48.5
• Assess nutrition supplements (sodium, potassium and calcium disorders)	2	6.1	5	15.1	12	36.4	14	42.4
• Assess presence of seizure (sodium disorder)	2	6.1	6	18.2	4	12.1	21	63.6
• Assess skin turgor, color and mucus membrane	3	9.1	3	9.1	8	24.2	19	57.6
• Assess muscle for tone, strength, cramp and twitching in sodium disturbance	4	12.2	8	24.2	8	24.2	13	39.4
• Assess for hypoactive or hyperactive reflexes and muscle strength	1	3.0	6	18.2	10	30.3	16	48.5

(potassium and calcium disorder)									
• Assess ECG changes (potassium and calcium disorder)	0	0.0	4	12.2	11	33.3	18	54.5	
• Check peripheral perfusion: capillary refill and peripheral pulses (potassium and calcium disorder)	0	0.0	7	21.2	11	33.3	15	45.5	
• Assess for positive trousseaus traid , chvosteks signs in hypocalcaemia	13	39.4	4	12.2	6	18.2	10	30.3	

Table (2): Describes the nurses' opinions concerning assessment methods required for fluid and electrolyte nursing standard. The results indicated that 63.6%, 57.6%, and 54.5% respectively of the studied PICU nurses were

strongly agreed that the presence of seizure, assess skin turgor, color, and mucus membrane, and assess ECG changes were assessment criteria that should be included in the management plan of fluid disturbances.

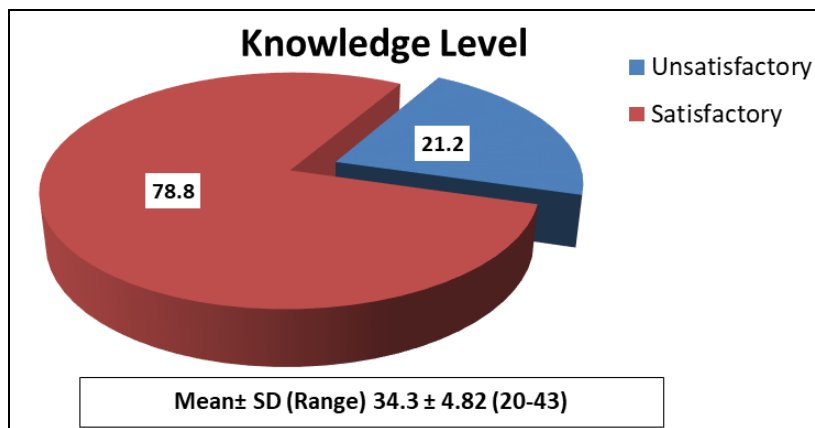


Fig 1: Knowledge level of studied PICU nurses concerning assessment methods required for fluid and electrolyte nursing standard (n=33):

Figure (1): Indicates the knowledge level of studied PICU nurses concerning assessment methods required for fluid and electrolyte nursing standards. It was detected from this figure that more than three-quarters (78.8%) of the nurses

had a satisfactory knowledge level. While only 21.2% had an unsatisfactory knowledge level about the methods required for fluid and electrolyte balance.

Table 3: Nurses' practices for maintaining fluid balance of critically ill children during the first and second assessments (n=33)

Basic Competencies	First Assessment						Second Assessment						P. value
	Not Done		Done incompletely		Done Completely		Not Done		Done incompletely		Done Completely		
	No	%	No	%	No	%	No	%	No	%	No	%	
Fluid Parameters Measurement:													
• Measure of CVP/hour accurately	27	81.8	6	18.2	0	0.0	23	69.7	8	24.2	2	6.1	0.272
• Measure of fluid intake and output/hour accurately	0	0.0	7	21.2	26	78.8	0	0.0	5	15.1	28	84.8	0.523
• Weigh patient daily	11	33.3	22	66.7	0	0.0	10	30.3	17	51.5	6	18.2	0.035*
Signs and Symptoms indicating For Fluid disturbance:													
• Auscultate chest sound	26	78.8	7	21.2	0	0.0	23	69.7	8	24.2	2	6.1	0.325
• Assess presence of edema	0	0.0	20	60.6	13	39.4	1	3.0	11	33.3	21	63.6	0.064
• Assess flat/distended neck vein	8	24.2	24	72.7	1	3.0	3	9.1	20	60.6	10	30.3	0.007**
• Assess skin turgor, color and mucus membrane	5	15.2	18	54.5	10	30.3	2	6.1	12	36.4	19	57.6	0.071
Nursing interventions towards maintaining fluid balance:													
• Monitor laboratory results	32	97.0	1	3.0	0	0.0	31	93.9	1	3.0	1	3.0	0.602
• Change patient's position /2 hours	6	18.2	11	33.3	16	48.5	6	18.2	10	30.3	17	51.5	0.962
• Provide skin care to edematous part and check bony prominence	2	6.1	11	33.3	20	60.6	0	0.0	8	24.2	25	75.8	0.220
• Increase or restrict fluid intake as ordered	1	3.0	2	6.1	30	90.9	0	0.0	2	6.1	31	93.9	0.602

-Chi-square test *Significant difference at p. value<0.05, **Significant difference at p. value<0.01

Table (3): Presents the nurses' practices for maintaining the fluid balance of critically ill children during the first and second assessments. Regarding the measurement of the fluid parameter: The results revealed that 81.8% and 69.7 % of the PICU nurses didn't measure CVP/hour in the first and second assessments respectively. Also, 78.8% of them were

completely measured the fluid intake and output/hour in the first assessment compared to 84.8% in the second assessment. Moreover, the results found that 66.7% of the nurses were weighted the patients daily by incomplete ways in the first assessment which decreased to 51.5 % in the second assessment with a statistically significant difference

between first and second assessment ($p= 0.035^*$). Regarding assessment the signs and symptoms of fluid imbalance; high percentage 78.8% and 69.7% of the studied PICU nurses didn't perform the chest auscultation in the first and second assessments respectively. Furthermore, less than two-thirds of the nurses (60.6%) were assesses the presence of edema incompletely in the first assessment vs. 33.3 % of them in the second assessment. Concerning neck vein assessment 72.7% vs. 60.6% of them did it incompletely when managing fluid disturbance in the two assessments with a statistically significant difference between first and second assessment ($p= 0.007^{**}$). In addition 54.5% of the nurses assess skin turgor, color and mucus membrane by incomplete way when managing fluid

disturbance in the first assessment compared to 36.4% of them in the second assessment. Additionally as regards the nursing interventions towards maintaining fluid balance; it was noted that the majority of PICU nurses (97.0% and 93.9%) didn't monitor the laboratory results in the first and second assessments. Finally the present study found that 48.5%, 60.6% and 90.9 % respectively of the nurses were competent in changing patient's position, performing skin care and determining the amount of fluid intake in the first assessment compared to 51.5%, 75.8% and 93.9% respectively in the second assessment with no statistically significant difference between the first and second assessments .

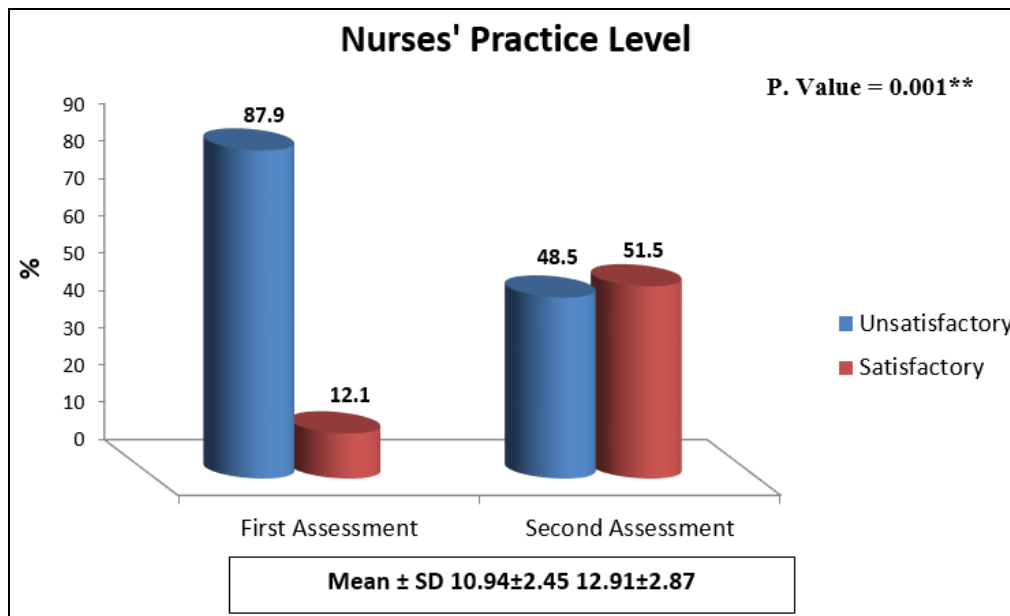
Table 4: Comparison between Mean score of the first and second assessments related to nurses' practice subdomains (n=33)

Nurses' Practice Subdomains	Max Score	First Assessment	Second Assessment	P. value
		Mean+ SD	Mean+ SD	
• Fluid parameters measurement	6	2.64 ± 0.6	3.09 ± 1.01	0.030*
• Signs and symptoms indicating for fluid disturbance	8	3.55 ± 1.28	4.7 ± 1.63	0.002**
• Nursing interventions towards maintaining fluid balance	8	4.76 ± 1.35	5.12 ± 1.19	0.250
Nurses' Practice	22	10.94 ± 2.45	12.91 ± 2.87	0.004**

Independent T-test *Significant difference at $p. value < 0.05$, **Significant difference at $p. value < 0.01$

Table (4): Illustrates the comparison between Mean score of the first and second assessments related to nurses' practice subdomains. The results indicated that statistically significant differences were detected as regards fluid

parameters measurement, signs & symptoms indicating for fluid disturbance, and the total nurses' practice ($p=0.030^*$, 0.002^{**} , 0.004^{**}) respectively.



-Chi-square test **Significant difference at $p. value < 0.01$
Independent T-test **Significant difference at $p. value < 0.01$

Fig 2: Total level of nurses' practice during the first and second assessments for the study sample (n=33)

Figure (2): Reveals the total level of nurses' practice during the first and second assessment for the study sample. It was clear from this figure that the majority of the nurses (87.9%) had unsatisfactory practice in the first assessment which declined to 48.5% in the second assessment with statistically significant difference ($p= 0.001^{**}$).

4. Discussion

Fluid and electrolyte disturbances are the most frequently reported problems in PICUs. These disturbances are associated with high morbidity and mortality rate among critically ill children. Early detection and management of fluid and electrolyte imbalance can improve children's outcomes, decrease the length of intensive care stay and reduce the cost of health care services (Hu *et al.*, 2017 and Lee, 2010) [20, 23]. Strategies to manage fluid and electrolyte

imbalances occur across the life span and should involve education, medication review, accurate intake and output measurements and recordings, and fluid and electrolyte replacement (Kear, 2017) [22].

The aim of this study was develop nursing standard for maintaining fluid and electrolyte balance for critically ill children at Pediatric Intensive Care Unit.

The current study findings showed that more than three-quarters of the studied PICU nurses had a satisfactory knowledge level regarding the proposed nursing standard for maintaining fluid and electrolyte balance for critically ill children in PICU. These findings were concurrent with the results of Leilah *et al.*, (2019) [24], Asfour (2016) [4], and Vijayan (2011) [35] they found that there was an adequate level of knowledge among the studied nurses. While the results were not concurrent with the results of Aslam *et al.*, (2017) [5] who indicated that the studied nurses had an overall low level of knowledge concerning fluid and electrolyte administration.

The present study results indicated that more than two-thirds of PICU nurses were strongly agreed that the presence of seizure indicated sodium disorders and it should be included in the management plan of fluid disturbances. These findings were in agreement with Leilah *et al.*, (2019) [24]. Likewise, the studies by Halawa (2017) [17] and Nardone *et al.*, (2016) [27] investigated the seizure and suggested "monitoring of seizures for patients who have electrolyte disturbances in ICUs".

In addition; the results showed that more than half of PICU nurses were strongly agreed that assessment of ECG changes indicated a potassium and calcium disorder of a critically ill child and it should be included in the management plan of fluid disturbances. The finding was consistent with a study conducted by Leilah *et al.*, (2019) [24]. Also, the results were synchronized with Tongyoo *et al.*, (2018) [34] and Gardner *et al.*, (2014) [16] they found that an association between a higher incidence of ventricular arrhythmia among ICU patients and electrolyte disturbances. However, the results were disagreeing with Cohen *et al.*, (2012) [10].

Moreover, the results found that more than half of PICU nurses were strongly agreed that skin turgor, color, and mucous membrane were assessment criteria that should be included in the management plan of fluid disturbances. This result was in the same line as Leilah *et al.*, (2019) [24]. This result might be due to all PICU nurses can assess the degree of dehydration through skin turgor and mucous membrane.

The present study found that slightly more than one-third of the nurses were agreed and less than half of them strongly agreed about the importance of measure fluid intake and output /hour and assess changes in body weight daily as an assessment method required for fluid and electrolyte nursing standard. These results were in the same line with Terris & Crean (2014) [32] who mentioned that an accurate daily fluid balance should be recorded to show the total fluid intake and output. Ideally, the child should be weighed on admission and daily whilst receiving intravenous fluids.

Concerning the total level of nursing practice during the first and second assessments for the study sample. The present study indicated that the majority of the nurses had unsatisfactory practice in the first assessment which improved and decreased to less than half in the second

assessment with a statistically significant difference. The results were in the same line with Mohamed *et al.* (2019) [26] who mentioned that more than three-quarters of the nurses in the PICU had unsatisfactory practice in the auditing with enhancement in their practice in re auditing. Also, the present results were consistent with Cooper (2019) [11]. From the researchers' viewpoint, the findings of the present study may be attributed to nursing staff shortage, nursing work overload, the time constraints to connect with a large number of patients within a limited time, and lack of knowledge and awareness as a result of a lack of training programs about fluids and electrolytes, as our findings illustrated. Also, using the study nursing standard enhanced their knowledge and consequently their practice.

The present study revealed that the majority of the nurses in the first assessment didn't measure CVP/hour accurately compared to more than two-thirds of them in the second assessment. The current study was in the same line with Leilah *et al.*, (2019) [24] who showed that a higher percentage of nurses were incompetent in monitoring CVP. Also, the results were in agreement with Hassan (2018) [18]. It could be suggested that reducing the nurse-patient ratio in pediatric ICU to 1:1 can contribute to accurate measurement and documentation of patients' parameters. In addition; education related to maintaining fluid and electrolyte balance in children is often targeted at parents or caretakers. Such education should include the important fact that children can quickly become dehydrated (Kear, 2017) [22].

Moreover, the current results showed that a high percentage of the nurses were competent in measuring and recording fluid intake and output in the first and second assessments. This was emphasized by the study conducted by Asfour (2016) [4] which revealed that more than two-thirds of the recorded fluid balance chart was accurate and complete. This can be explained by the best practice indicates that intake and output measurement and recordings are an inter-professional responsibility. They are not primarily the responsibility of the nursing assistant or patient care technician, but the responsibility of all staff (Severs *et al.*, 2015) [30]. But the results in contrast with a study conducted by Vincent *et al.*, (2015) [36] who reported that nurses' performance regarding measuring fluid intake and output was low.

The present findings noticed that more than two-thirds and more than half of the nurses in the first and second assessments respectively were measured the patients' weight incompletely with a statistically significant difference. These results were consistent with Leilah *et al.*, (2019) [24] who mentioned that in the study settings, the weighing scale was not available; therefore, weight assessment was not done completely for all patients. This could be explained by most of children in the pediatric intensive care unit were in a critical condition as on mechanical ventilation or on oxygen therapy so the nurses were not able to weigh them.

Diacon and Bell (2012) [12] stated that the most important aspects affecting nurses' accuracy of fluid balance monitoring, recording and calculation are workload and time management, lack of training, inexperience, inaccuracy of the measuring equipment, communication with other health-care workers, distractions and uninformed visitors. Also, the results of Asfour (2016) [4] indicated that there was a lack of in-service education and training regarding the

basic nursing cares. Moreover, shortage of nurses increases the workload on the existing staff which may lead to errors in monitoring fluid balance.

5. Conclusion

It was concluded from the study results that more than three-quarters of the PICU nurses had a satisfactory knowledge level. Also, the majority of the nurses had unsatisfactory practice in the first assessment which improved in the second assessment with a statistically significant difference. Furthermore, the results indicated that statistically significant differences were detected as regards the mean score of the first and second assessments related to nurses' practice subdomains in fluid parameters measurement, signs & symptoms indicating fluid disturbance, and total nursing practice.

6. Recommendations

1. Pediatric intensive care nurses should update their knowledge and practice through continued nursing education, training, and frequently attending seminars and conferences on maintaining fluid and electrolyte balance of critically ill children.
2. The developed nursing standard about fluid and electrolytes should be evaluated for its effectiveness on critically ill children's outcomes.
3. Educational guidelines, posters, pamphlets, and manuals on maintaining fluid and electrolyte balance of critically ill children should be provided and be available at PICU.

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