Effect of Educational Intervention Program on Nurses' Performance regarding Post Intensive Care Syndrome and Bundles of Care for Critically Ill Children

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Abstract

Background: Post-Intensive Care Syndrome represents a significant risk to the well-being and quality of life domains of the pediatric survivors subsequent to their discharge from Pediatric Intensive Care Units. **The study's aim** was to evaluate the effect of educational intervention program on nurses' performance regarding Post Intensive Care Syndrome and bundles of care for critically ill children. **Research design**: A quasi-experimental study design was employed. **Setting**: The study was applied at Pediatric Intensive Care Unit of Tanta International Educational Hospital. **Sample**: A convenient sample of 50 nurses were recruited. **Tools**: Tool (I): Nurses' Knowledge Structured Questionnaire to identify nurses' awareness about Post Intensive Care Syndrome & **Tool (II):** ABCDEF Bundle Observational Checklist. **Results**: 90% & 98% of nurses had low knowledge regarding Post Intensive Care Syndrome and unsatisfactory practice regarding ABCDEF care bundle pre intervention respectively while, 92% & 86 % of the same sample exhibited high level of knowledge and satisfactory practice immediately following the educational intervention application respectively. **Conclusion**: educational intervention significantly improved nurses' performance regarding Post Intensive Care Syndrome and bundles of care for critically ill children. **Recommendations**: written standard policies regarding bundles of care should be available in every pediatric intensive care unit as well as regular training programs for nurses about Post Intensive Care Syndrome.

Key words: Bundles of care, Critically ill children, Nurses' Performance, Post Intensive Care Syndrome

Introduction

Millions of children around the world suffer from critical illness that requires a Pediatric Intensive Care Unit (PICU) admission. Reducing mortality rate among children with severe illness is no longer the only outcome especially with the recent advances of PICU treatment and interventions. The long term implications affecting children liberated from PICU have prompted interests from families and health care professionals (**Manning, Pinto, Rennick, Colville, & Curley, 2018; Tang, Xu, Su, Huang, & Zhang, 2021)**.

Children and their families are compelled to cope with newly emerged conditions or modified functional capacities, as a probable outcome of critical illness and extended PICU stay. The detrimental consequences endured by pediatric survivors and their families have been delineated as Post-Intensive Care Syndrome (PICS) **(Hayes, Harding, Blackwood, & Latour, 2024; Chaiyakulsil, Opasatian, Tippayawong, 2021)**.

Post-Intensive Care Syndrome refers to worsened decline in one or several aspects of a child's physical, emotional, cognitive and social functioning subsequent to their discharge from PICU. Opioid and sedation usage, the severity of medical conditions, extensive life-sustaining interventions and social isolation constitute considerable risk factors for the onset of PICS (**Ekim, 2020**; **Inoue et al., 2024)**.

Physical and functional impairments associated with PICS are significant. It was reported that more than 63% of survivors frequently exhibit symptoms of fatigue, muscular weakness, nociceptive discomfort, challenges with feeding, growth retardation, inadequate sleep, disabilities, and physical dependence that impact their daily lives (**Perry-Eaddy, Dervan, Manning, Watson, & Curley, 2023)**.

Social outcomes of PICS include; delays in personal and social development leading to social isolation, identity issues, challenges in participating in recreational activities, struggles with school adjustment and school absenteeism **(Kyösti et al., 2020; Perry-Eaddy, Dervan, Manning, Watson, & Curley, 2023; Ducharme-Crevier et al., 2021)**.

Cognitive deficits related to PICS vary significantly, ranging from minimal to severe impairment including; neuro - psychological function impairment up to 6 months after discharge. Limitations of cognitive ability, variations in intelligence quotient and attention may last for one year post hospital departure. Difficulties with school works, memory and speech fluency have also been documented in the age range of 5 to 16 years **(Christie, 2021; Hartman, Williams, Hall, Bosworth, & Piantino, 2020; Chaiyakulsil, Opasatian, & Tippayawong, 2021)**.

Emotional deteriorations may last for months as fear, anger, delusions, anxiety, sadness, and post-traumatic stress disorder. Family members also

experience psychological, physical and financial problems as; exhaustion, despair, family dynamics instability, and poor adjustment to work and home duties **(Bradbury et al., 2021; Rahmaty, Manning, MacDonald, & Perez, & Ramelet, 2023)**.

A collaboration of intensive care professionals has designed a multi-component PICU care principles for prevention of PICS. It is widely known as ABCDEF bundle that addresses the threats of sedation, delirium, and immobility. This bundle is composed of (A); Assess, prevent and manage pain, (B); Both spontaneous awakening and breathing trials, (C); Choice of analgesia and sedation, (D); Delirium assessment, prevention, and management, (E); Early mobility and exercise. Furthermore, (F); Family involvement (**Ismaiel, Mohammed, Ameen, & Abdelatef, 2022; Engel et al., 2022; Lin et al., 2023)**.

Assessing and controlling pain is one of the most important practices at PICU. Managing pain and discomfort can be achieved through the application of objective assessments. The most validated pediatric pain tools are the revised " Face, Legs, Activity, Cry, Consolability Scale " (FLACC) for children who are unable to speak from 0 to 6 years of age, the " Numeric Rating Scale" (NRS) is used for cognitively impaired nonverbal children aged 6 years or more, "Behavioral Pain Scale" and "Wong-Baker Faces Pain Rating Scale" for verbal children with the age of 3 years or older. Non-pharmacological interventions should be considered beside medications use for pain relief as; repositioning, distraction, heat/cold compresses, massage therapy, music therapy, and child life therapy (**Smith et al., 2022; Giordano et al., 2019)**.

Spontaneous awakening and breathing trials are not commonly used in the PICU. It is a protocol for pauses in sedation and artificial ventilation to monitor the severely ill children while alert to any indicators of readiness for extubation. Regular application of bundle B can reduce mechanical ventilation time and sedatives over doses (**Engel et al., 2022)**.

Analgesia and sedation are given typically to facilitate invasive procedures. Over sedation occurs in most mechanically intubated children, which is the main risk factor for delirium and immobility. Regular evaluation of sedation doses using the "Richmond Agitation and Sedation Scale" (RASS) and the "Riker Sedation-Agitation Scale" (SAS) are linked to low delirium occurrence and better health outcomes (**Huang et al., 2021; Bardwell, Brimmer, & Davis, 2020)**.

Delirium is characterized by acute alteration in mental status, inattention, abnormal wake sleep cycles, and cognitive dysfunction. The severity of delirium fluctuates through the day, often being worse especially at night. Hence, routine assessment should be the standard of care in all PICUs, and delirium prevention strategies should be given priority.The most validated delirium screening tools used for children: the "Cornell Assessment of Pediatric

Delirium" (CAPD), which is suitable for children at any age, and the "Pediatric Confusion Assessment Method for the Intensive Care Unit" (PCAM-ICU), which can be employed for children older than 6 months (**Dornette, Deptola, Hemmann, Venkatesan, & Cortezzo, 2024** ; **Smith et al., 2022)**. Early mobilization is effective technique for reducing the occurrence of muscle weakness, improving the physiological function and the general health status. Starting mobility depends on the children's stage of illness, their tolerance and cardiorespiratory response. Nurses should screen children for readiness to mobilize each day and maintain safety measures to prevent accidents and devices dislodgement (**Zhang et al., 2023; Alqahtani et al., 2022)**.

Family engagement is an essential element of the ABCDEF bundle as no ICU treatment plan is complete without incorporation of the family's wishes, worries, questions and involvement. The participation of family in the caregiving processes concerning their children represents a constructive advancement that leads to increased children's comfort, diminished anxiety and the provision of competent care **(Walz, Canter, & Betters, 2020)**.

Pediatric intensive care unit nurses are in great position to provide comprehensive and evidence – based care for children with critical illnesses through the implementation of ABCDEF care bundle. This bundle create consistent care systems in hospitals, foster recovery and prevent potential disabilities. However, limited studies are available on the implementation of the bundle in the pediatric groups **(Dalli, Doğan, Bayram, Pehlivan, & Yildiz, 2024)**.

Significance of the study:

Critical illness and admission to PICU are stressful situations. It was estimated that the admission rate of children at Pediatric Intensive Care Unit of Tanta University International Teaching Hospital in 2023 is 250 children per year **(Statistical Office of Tanta University International Teaching Hospital, 2023)**.

Post Intensive Care Syndrome can occur not only in pediatric patients but also in the whole family members and may persist after discharge. It was estimated that at least one-third of ICU pediatric survivors and their families experience PICS resulting in functional limitations and increase in health care expenditures **(Tejero-Aranguren et al., 2022; Zhou et al., 2023; Flaws & Manning, 2021).**

Nursing staff working in PICUs must have complete information about the possible effects, prevention and management of PICS well as the compliance with ABCDEF bundle guidelines in daily critical care routines. Therefore, structured and repeated training is a necessity (**Ekim, 2020**). So, the study's objective was to evaluate the impact of educational intervention program on nurses' knowledge and practice regarding Post Intensive Care Syndrome and bundles of care for children with critical illness.

Aim of the study was to:

Evaluate the effect of educational intervention program on nurses' performance regarding Post Intensive Care Syndrome and bundles of care for critically ill children.

Research hypotheses:

- Nurses' knowledge regarding Post Intensive Care Syndrome is expected to be improved after the implementation of the educational intervention program.
- Nurses' practice regarding bundles of care for critically ill children is expected to be enhanced after the educational intervention program implementation.

Subjects and Method

Subjects:

Research design:

A quasi-experimental research design was utilized to achieve the study's goal.

Setting:

The study was accomplished at Pediatric Intensive Care Unit of Tanta International Educational Hospital which is affiliated to the Ministry of Higher Education and Scientific Research. It locates in the fourth floor and consisted of three rooms with 8 beds and 8 ventilators.

Subjects:

A convenience sampling of 50 nurses caring for children with critical illness in the previously stated setting.

Tools of data collection:

Tool I: Nurses' Knowledge Structured Questionnaire

It was developed and written in Arabic language by the researchers. It was composed of two main parts:

Part (1): Socio-demographic characteristics of the studied nurses: such as; age, sex, marital status, qualifications, experience years, previous workshops about Post- Intensive Care Syndrome.

Part (2): Nurses' knowledge regarding Post Intensive Care Syndrome

The researchers designed this part after analyzing the recent literatures and expert comments for content validity (**Ekim, 2020; Hayes, Harding, Blackwood, & Latour, 2024**). It was comprised of nurses' knowledge regarding the following:

a. **Post Intensive Care Syndrome**: such as: definition, risk factors, associated problems, manifestations of physical, psychological and social impairments and school performance.
b. **Preventive measures for Post Intensive Care Syndrome (Bundles of Care)** it included: components of ABCDEF bundle, pain evaluation scales (for pediatric patients with and without communication problems), frequency for spontaneous awakening and breathing trials, delirium meaning and assessment tools as well as benefits of early mobility.

The total questions were 14 questions. The sum of all items was 28 grades. Each question was evaluated based on the following criteria: Responses that are both correct and complete was received 2 marks, score (1) was given for correct incomplete answers and score (zero)

for wrong answers or not answered questions.

The total scores of Nurses' knowledge was calculated and classified as follows:

1. A score of 80% and more was considered high level of knowledge.
2. The score from 60% - < 80% represented moderate knowledge level.
3. Less than 60% represented low knowledge level.

Tool II: ABCDEF Bundle Observational Checklist

The researchers developed the observational checklist on the basis of updated literatures to assess nurses' practice regarding ABCDEF care bundle for severely ill children (**Engel et al., 2022; Lin et al., 2023; Marra, Ely, Pandharipande, & Patel, 2017)**. It was composed of six basic items:

- Bundle A: Assessment of pain using Numerical Rating Scale for conscious children and Behavioral Pain Scale for unconscious pediatric patients.
- B: Both spontaneous awakening trials (daily stopping of sedatives) and breathing trials (protocol of ventilator weaning) for intubated children.
- C: Choice of analgesia and sedation using Richmond Agitation Sedation Scale (RASS).
- D: Delirium evaluation through the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU).
- E: Early movement and exercise for conscious and unconscious children
- F: Family engagement and empowerment during their children's stay at the critical units.

Scoring system for nurses' practice regarding ABCDEF bundle

- Each step done correctly was scored (1) mark and a (0) mark if the step not done. The total practice score was calculated and subsequently converted to a percent score.

The total level of nurses' practice was categorized as follows

Satisfactory practice if the nurse received a score of ≥ 80%. If the nurse received a score lower than 80 %, the practice was unsatisfactory.

Method

The study was conducted via performing the subsequent steps:

1- Administrative process: the study researchers was obtained an official permission from Dean of Faculty of Nursing at Tanta University and directed to the general manager of Pediatric Intensive Care Unit for conducting the research.

2-Ethical considerations:

Approval of the ethical committee was acquired from the Faculty of Nursing at Tanta University, with the specified code number 159-12-2022. Nurses were oriented about the study's goals, advantages and nature as well as their right to leave from it at any time. Verbal and written agreement was gained before they took part in the study. The participants also were informed that data will be used for research purposes only. Through the coding of all data and the protection of all information taken, each subject's

confidentiality and anonymity were guaranteed.

3- Development of the study tools:

The investigators reviewed and used textbooks, papers, scientific periodicals and all relevant literatures related to PICS. This assisted in understanding the research challenges and creating the study tools. The researchers used two tools for collecting data.

4-Content Validity:

The research tools were introduced to a panel of five experts, including three in Pediatric Nursing from the Faculty of Nursing and two professors of pediatrics from the Faculty of Medicine at Tanta University. Content validity index was 97%.

5- Reliability of Tools:

The reliability of the proposed tools was tested through Cronbach's Alpha test which was 0. 78 for tool I & 0.86 for tool II.

6- Pilot study: was applied on 10 % from the total sample size (five nurses) and subsequently dropped from the main sample. The purpose of the pilot study was to evaluate the viability and application of the study tools, clarity of sentences and the time needed to collect the required data; unnecessary items were omitted, and required modifications were made.

Fieldwork:

The researchers interviewed the studied nurses who were employed at Pediatric Intensive Care Unit and explained the purpose, methods, advantages, and time frame of the study. The researchers then conducted an interview with each nurse separately, which took between 10 and 15 minutes to determine their understanding about PICS. The researchers then started assessing nursing care while performing their real job for each critically ill child three days per week prior the educational intervention program. Thereafter, nurses were given educational sessions regarding PICS and bundles of care. Subsequent evaluations of nurses' knowledge and practice were took place.

The actual fieldwork accomplished within four months from February 2024 to May 2024. The research was done via four phases:

A. Phase of Assessment:

Nurses were interviewed individually by researchers pre the educational intervention program to collect sociodemographic data and knowledge about Post Intensive Care Syndrome using **Tool I.** Nurses' practice regarding ABCDEF care bundle was assessed with the use of **Tool II**.

B. Phase of Planning:

Based on the work completed in the assessment phase; the researchers formulated objectives, priorities and expected outcomes to meet nurses' educational needs regarding Post Intensive Care Syndrome and bundles of care. The study researchers constructed the educational program guidelines. The educational intervention sessions covered theoretical and practical skills. A guiding booklet was prepared by the researchers. It was written in simple clear Arabic language and supplemented by photos and illustrations. Different

teaching aids were prepared as Power Point Presentation containing videos and pictures to promote nurses' awareness of the content.

C. Phase of Implementation:

The developed educational sessions was conducted for the studied sample at PICU during the morning shift. The participants were classified into 10 groups; each group involved five nurses and took 5 sessions (3 theoretical sessions and 2 practical) each session lasted for 30-45 minutes.

The educational sessions covered the subsequent topics

The first session included an overview and objectives of educational intervention sessions, executing the pre-test by using the study tools and distributing the booklet.

The second session concentrated on definition, etiology and precipitating factors as well as associated problems of PICS.

The third session included manifestations of physical, intellectual, social and emotional impairments of PICS, impacts on school performance and management.

The fourth session: preventive procedures for PICS as: ABCDEF bundle (Assess, prevent and manage pain, spontaneous awakening and breathing trials).

The fifth session: practices related to ABCDEF bundle (Choice of analgesia and sedation, delirium assessment and management, early mobility and exercise and family engagement and empowerment).

D. Evaluation Phase

Following the completion of the educational sessions, the posttests were done immediately and one month later of the educational program implementation using the same tools to determine the effectiveness of the educational intervention on nurses' performance about Post Intensive Care Syndrome and bundles of care and compared to pretest results.

Statistical analysis:

Data collection process was performed and statistically analyzed via Statistical Package for the Social Sciences (SPSS) version 26. Range, mean and standard deviations were used for numerical values. Qualitative data was described by frequency, percentage or proportion of each category. T-test was used to compare between means of two groups of parametric data of independent samples, comparison between two groups and more was done through Chi-square test and the difference among mean values of more than two categories was done by analysis of variance (ANOVA). Correlation between variables was evaluated through Pearson and Spearman's correlation coefficient r. Level of significance was adopted at $p < 0.05$.

Results:

Table (1) clarifies the percent distribution of socio-demographic characteristics of the studied nurses. It was found that 72 % of nurses, their age ranged from 20 to less than 30 years. In addition, 92% and 82% of them are females and married respectively. Regarding their qualifications, experience years and

PICS workshops, it was discovered that, 50% had Bachelor of Nursing Sciences, 58% had less than five years' experience and 98% of them did not attend any workshops regarding PICS.

Table (2) demonstrates total knowledge scores of the studied nurses regarding Post Intensive Care Syndrome. It was found that the majority of nurses (90%) obtained low knowledge scores pre educational intervention program while 92% and 86% of them had high knowledge levels immediately post the program and after one month. It was discovered that the higher means scores found during the immediate and post one month of the program implementation (24.040 ± 1.603 & 23.760 ± 1.478) respectively. The table also showed a high statistically significant differences during pre-immediate phase and pre- after one month of the educational program (p = 0.0001).

Table (3) presents distribution of the studied nurses' practice regarding ABCDEF bundle of care for children with critical illness. In relation to assessment of pain, it was illustrated that less than two thirds (62%) of nurses didn't perform this step pre-educational sessions. While the majority of the studied participants (92% & 90%) assessed the pain directly after the educational sessions and during follow up respectively. Additionally, a significant differences were found between pre and immediate & pre and one month later (0.0001).

As regards awakening and breathing assessments, 88% of the studied subjects didn't execute these steps while, most of them (88% & 84%) implemented it immediately post the educational intervention and one month later respectively.

This table also reveals that 54% of nurses assessed levels of sedation and analgesia using Richmond Agitation-Sedation Scale pre educational sessions compared to 100% & 82% monitored sedation values appropriately immediately and one month post intervention respectively. There was a highly significant difference during all phases of the study (0.0001, 0.001, 0.002) respectively.

In the context of delirium assessment, it was found that, 88% of the studied sample didn't evaluate delirium pre educational intervention whereas 88% & 80% of them monitor delirium effectively immediately after the learning intervention and one month later respectively. The table also shows a highly statistically difference in all the study phases (0.0001, 0.0001, 0.041) respectively.

The table reveals that, 72% of nurses didn't mobilize children early prior intervention, while 86% & 82 % of them carried out early mobility for children immediately after educational intervention and post one month respectively. Concerning family involvement, 78% of nurses didn't involve family during the child care and then 90% of them maintained family involvement during the immediate phase and post one month of intervention.

Figure (1) demonstrates percent distribution of the total practice scores regarding ABCDEF bundle for

critically ill children. It was found that 98% of nursing staff had unsatisfactory practice prior the program sessions while, 86%% & 84% of nurses had satisfactory practice shortly after the educational intervention implementation and one month later respectively.

Table (4) clarifies a statistically significant association between marital status and nurses' knowledge before and one month following the intervention (p = 0.0001, p = 0.027) respectively. Regarding to relation between qualifications of nurses and their knowledge, it was observed that, a highly statistically relation in between immediately post the intervention and following one month (0.0001). This table also illustrates a highly statistically significant relation among total knowledge scores and experience years pre, immediately and following one month of the educational program application (p= 0.0001, p = 0.011, p = 0.003) respectively.

Table (5) presents a highly significant relation among nurses' total practice scores and marital status as well as qualifications pre educational intervention (p = 0.0001). On the other side, there were no statistically relation in-between them immediately post the intervention and one month later (p = 0.315, p = 0.523 & p = 0.456, p = 0.564) respectively. Furthermore, a highly statistically significant relation was found among years of experience and nurses' practice pre, immediately after the educational intervention and at follow up (p = 0.0001, p = 0.003 and p= 0.001) respectively.

Table (6) reveals a positive correlation between nurses' knowledge and their practice before, immediately and one month following the educational intervention (r=0.478, p = 0.0001 and r =0.316, p = 0.024* and r = 0.429, p = 0.002**) respectively.

Table (1): Percent Distribution of Socio-Demographic Characteristics of the Studied Nurses

Socio-demographic characteristics data	The studied nurses (n=50)	
	No.	%
Age (years):		
20 - < 30	36	72.0
30 - < 40	14	28.0
Range	**20 – 39**	
Mean ± SD	**28.62 ± 4.676**	
Sex		
Male	4	8.0
Female	46	92.0
Marital Status		
Single	5	10.0
Married	41	82.0
Widow	1	2.0
Divorced	3	6.0
Qualifications		
Health Technical Institute	21	42.0
Bachelor of Nursing Sciences	25	50.0
High studies	4	8.0
Years of experience		
< 5 years	29	58.0
5 – 10 years	21	42.0
Work shop attendance		
Yes	1	2.0
No	49	98.0

Table (2): Total Knowledge Scores of the Studied Nurses about Post Intensive Care Syndrome

Total knowledge Scores	The studied nurses (n =50)						χ^2 P1	χ^2 P2	χ^2 P3
	Before		Immediate		Post one month				
	No.	%	No.	%	No.	%			
Low knowledge	45	90.0	0	0.0	0	0.0			
Moderate knowledge	5	10.0	4	8.0	7	14.0	**91.111**	**88.333**	0.919
High knowledge	0	0.0	46	92.0	43	86.0	**0.0001****	**0.0001****	0.338
Range	4: 22		20: 28		20: 28				
Mean ± SD	6.920 ± 4.222		24.040 ± 1.603		23.760 ± 1.478				
F value	638.399								
P	0.0001**								

** Highly Statistically difference at (P<0.01)
P1 Before & immediate
P2 Before & after one month
P3 Immediate & one month later

Table (3): Percentage Distribution of Nurses' Practice regarding ABCDEF Bundle of Care for Critically Ill Children

Total practice items		Total Sample (n=50)								
		Before		Immediate		Post one month		X^2\P1	X^2\P2	X^2\P3
		No.	%	No.	%	No.	%			
Assessing pain	**Done**	19	38	46	92	45	90	32.04 **0.0001****	24.34 **0.0001****	0.122 0.727
	Not Done	31	62	4	8.0	5	10			
Both Spontaneous Awakening & Breathing trials	**Done**	6	12	44	88	42	84	57.67 **0.0001****	60.86 **0.0001****	0.332 0.564
	Not Done	44	88	6	12	8	16			
Choice of analgesia and sedation using (RASS)	**Done**	27	54	50	100	41	82	29.87 **0.0001****	10.51 **0.001****	9.989 **0.002****
	Not Done	23	46	0.0	0.0	9	18			
Delirium assessment through Confusion Assessment Method for the ICU	**Done**	6	12	44	88	40	80	57.76 **0.0001****	49.17 **0.0001****	6.190 **0.041***
	Not Done	44	88	6	12	10	20			
Early mobility practice	**Done**	14	28	43	86	41	82	45.56 **0.0001****	27.21 **0.0001****	0.298 0.585
	Not Done	36	72	7	14	9	18			
Family involvement	**Done**	11	22	45	90	45	90	34.31 **0.0001****	36.05 **0.0001****	0.0001 1.000
	Not Done	39	78	5	10	5	10			

X^2. Chi square Test * Significance at p< 0.05 ** Highly Statistically difference at (P < 0.01)
P1.Before & immediate P2. Before & after one month P3. Immediate & one month

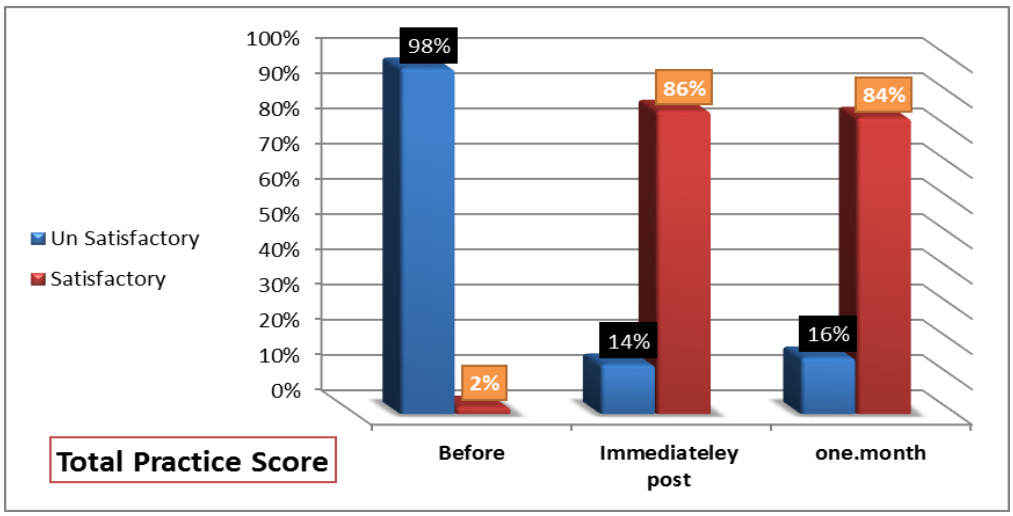

Figure (1): Percent Distribution of the Total Practice Scores regarding ABCDEF Bundle for Critically Ill Children (n=50)

Table (4): Relation between Nurses' Total Knowledge Scores and their Socio Demographic Characteristics

Socio-demographic data	Total knowledge scores (n =50)					
	Before		Immediate		Post one month	
	F value or t-test	P	F value or t-test	P	F value or t-test	P
Age in years	1.036	0.305	1.298	0.201	1.429	0.159
Marital Status	**17.910**	**0.0001****	2.305	0.098	**3.349**	**0.027***
Qualifications	2.787	0.072	**27.76**	**0.0001****	**10.34**	**0.0001****
Years of experience	**4.166**	**0.0001****	**2.643**	**0.011***	**3.149**	**0.003****
Work shop attendance	0.223	0.824	1.045	0.301	0.764	0.449

*** Significance difference at (P<0.05)**

**** Highly Statistically Significant difference at (P<0.01)**

Table (5): Relation between nurses' total practice scores and their socio demographic characteristics

Socio-demographic data	Total practice scores (n =50)					
	Before		Immediate		Post one month	
	F value or t-test	P	F value or t-test	P	F value or t-test	P
Age	0.007	0.994	0.285	0.777	1.156	0.253
Marital Status	**14.67**	**0.0001****	1.214	0.315	0.759	0.523
Qualifications	**13.54**	**0.0001****	0.799	0.456	0.580	0.564
Years of experience	**5.100**	**0.0001****	**3.830**	**0.003****	**2.943**	**0.001****
Workshops attendance	0.666	0.509	0.611	0.544	0.830	0.411

***Significance difference level at (P<0.05)**

**** Highly Statistically Significant difference at (P< 0.01)**

Table (6): Correlation between total nurses' knowledge and practice about post intensive care syndrome and bundles of care

Variables	Total knowledge level (n=50)		
	Before	Immediate	Post one month
	r P	R P	r P
Nurses' total practice scores	0.478 0.0001**	0.316 0.024*	0.429 0.002**

*** Statistically Significant difference at (P<0.05)**
**** Highly Statistically Significant difference at (P<0.01)**

Discussion

Recent improvements in devices and care provided for children at pediatric critical care units have minimized the death rates and increased the number of survivors from critical diseases. However, many complications affecting children might continue for months or even years causing long-term prognosis and poor quality of life (**Inoue et al., 2024**).

The study declared that half of the participants obtained Bachelor of Nursing Sciences. This might be clarified in the light of Pediatric Intensive Care Units require highly qualified skilled nurses capable of providing evidence based practices for critical cases. This finding was consistent with **Mohamed, Hassan, & El-Sheikh. (2020)** who observed that above fifty percent of the studied sample finished their university education. Similarly, **Barnes-Daly, Phillips, & Ely. (2017)** who discovered that below three quarters of the participants achieved high educational level. Also, **Zhang et al. (2023)** who noticed that nearly two thirds of nursing staff gained Bachelor's degree certificate.

The research revealed that almost all of nurses didn't attend any workshops regarding PICS. This may be due to unawareness of nurses' managers about negative and severe impacts affecting children after prolonged critical unit's hospitalization leading to absence of training workshops provided for nursing staff. This result was in line with **Mohamed, Hassan, & El-Sheikh. (2020)** who reported that more than ninety percent of the participants didn't receive any educational workshops about the concept of PICS. Similarly, **Zhang, Xie, & Tang. (2024)** who announced that below two thirds of nurses did not have any training courses.

In relation to nurses' knowledge about PICS. It was demonstrated that, ninety percent of the nurses had poor knowledge pre educational intervention. From the researcher perspective, PICS impacts are not realized to health care providers and there is no specific training program about PICS. These findings were parallel to the study carried out by **Yuan, Timmins, & Thompson. (2021); Von Borell, Engel, Neunhoeffer, Hoffmann, & Michel. (2022)** who mentioned that nurses were unaware of PICS concept and needed to expand their understanding on serious complications associated with pediatric critical settings. Similarly, Additionally, **Liang et al. (2021)** who stated that fifty percent of the involved ICU nurses exhibit a lack of understanding toward preventive care bundles for PICS.

The research indicated that the majority of the study participants gained high knowledge scores immediately after program and one month later. This reflected the magnitude of continuous nurses' education which affects the quality of care and patients' outcomes. These findings were in the same line with **Ekim (2020); Von Borell, Engel, Neunhoeffer, Hoffmann, & Michel. (2022)** who pointed to the urgent need for enhancing nurses' awareness on PICS. Also, **Alger, Owens, & Duffy. (2022)** who declared that standardized education for nurses regarding PICS can enable them to support children and their families during comprehensive care.

In relation to pain monitoring, it was illustrated that less than two thirds of nurses didn't assess pain pre educational sessions. While the majority of them performed this step directly after the program application and post one month. This could result from poor knowledge and absence of training programs conducted to nurses about ABCDEF care bundle leading to incompetent practice before the teaching intervention. Then their performance improved after the educational sessions due to the content of educational intervention was clear, simple and established according to nurses' learning needs as well as updated evidence – based nursing practice. Moreover, the use of different audiovisual aids which facilitate implementation of care bundle. This finding was in agreement with **Ismaiel, Mohammed, Ameen, & Abdelatef. (2022)** who proved that about two thirds of nurses had incompetent practice regarding pain assessment and management. Also, **McCudden et al. (2024)** who claimed that teaching sessions for nursing staff is needed to facilitate ABCDEF bundle implementation and consequently, improve clinical outcomes of children. Additionally, **Grunauer et al. (2021)** who stated that pain is an inevitable implications after pediatric ICU admission. Thus, pain evaluation and management are basic nursing procedures. On the opposite side, this result was contraindicated with **Ista et al. (2022)** who found that the majority of

the involved PICUs performed this practice routinely.

Concerning spontaneous awakening & breathing trials monitoring, it was observed that most nurses didn't perform these interventions pre-education. While most of them implemented these procedures immediately post the educational intervention and during follow up. This could be explained in the light of lack of nurses' awareness regarding ABCDEF and institutional support. In addition to the absence of written guidelines for unit practices then, their performance improved due to the effectiveness of teaching intervention program. The results were agreed with **Serena, Corredor, Fletcher, & Sanfilippo. (2019)** who mentioned that spontaneous awakening and breathing assessment are essential for evaluating a patient's readiness to be liberalized from the artificial ventilation. Similarly, **Shieh (2024)** who found that, the learning module increased nursing performance and confidence related to ventilator weaning.

This study showed that nearly half of PICU nurses did not monitor sedation and analgesia values compared to all of the participants assessed level of sedation immediately post the learning sessions. From the researchers' opinions this might be due to absence of written PICU protocols and low knowledge leading to poor practice. This was supported by **Amigoni et al. (2022)** who stated that, frequent pain and sedation evaluation are recommended to ensure the desired level of analgesia and sedation. **Jackson et al. (2024)** who informed that sedation and analgesia which were given for children requiring mechanical ventilation expose them to many challenges. On the other hand, the result was incongruent with **Kolmar, Kerley, Melliere, & Fuller. (2024)** who claimed that newer PICU nurses support the use of standardized sedation scoring systems pre education.

The current research demonstrated that, most of the studied sample didn't carry out delirium assessment pre program compared to most of them implemented this practice effectively immediately after the learning intervention. At the same line, **Ista etal. (2022)** who discovered that greater than half of nursing staff didn't do routine delirium monitoring. Also, **Zhang, Xie, & Tang. (2024)** reported that PICU nurses had low understanding and practical ability for delirium management. Moreover, **Semple, Howlett, Strawbridge, Breatnach, & Hayden. (2022)** added that Pediatric delirium is a common disorder in children with severe illness which require highly individualized care.

Regarding the practice of early mobilization**,** the study reported that nearly three quarters of the participating nurses didn't mobilize children early, while most of them carried out early mobility procedure immediately after educational intervention and post one month. This finding was consistent with **Zhang etal. (2023)** who observed that

slightly more than three quarters of nursing staff reported never assisting ventilated children with early movement and their practice regarding early mobility need for improvement. Also, **Alqahtani et al. (2022)** announced that about two thirds of ICU staff had no previous early mobilization training. Also, **Alaparthi, Gatty, Samuel, & Amaravadi. (2020)** claimed that early mobilization has positive influences on children's outcomes. However, it isn't well practiced in many countries.

Concerning family engagement, slightly greater than three quarters of nurses didn't perform this practice pre the program sessions. It is evident from researchers' perspectives that intensive care unit regulations prevent parents' presence inside the unit except during visiting time for infection control and lack of awareness regarding benefits of family participation in the child care. This result agreed with **Bahmane et al. (2024)** who reported that family involvement is crucial part of child care inside the intensive care unit as it enhances health outcomes, resources allocation, increased patient and family satisfaction. Similarily, **Farokhzadian, Forouzi, & Sheikhbardsiri. (2021)** who discovered that the facility barriers for applying the practice of family involvement are restricted family entry in the intensive care unit, small space, workload and negative attitude of nursing staff.

In relation to total performance scores regarding ABCDEF bundle, it was found that nearly all of nurses had incompetent practice prior program sessions while, most of them had competent performance immediately post the intervention implementation and after a month. This corresponds to the importance of continuous nursing guidance and hospital supervision on care bundles implementation. These finding was consistent with **Ismaiel, Mohammed, Ameen, & Abdelatef. (2022)** who found that above two thirds of nursing staff members had unsatisfactory practices regarding the ABCDEF bundle pre intervention. Also, **El-Feqi, Maarouf, & Ameen. (2023)** who noticed that about three quarters of the studied subjects had unsatisfactory practice regarding ABCDEF bundle compared to most of nurses had satisfactory level of practice immediately and post the teaching programs. **Lahati, Suhartini, & Anggorowati. (2024)** who encouraged standard protocols for the continuing care of post intensive care children. Furthermore, **Choong et al. (2024)** mentioned that regular nurses training, written practice guidelines and available resources facilitate the implementation of PICU-care bundle. The research showed a positive correlation between nurses' knowledge and their practice during all the study phases. This could be explained in the light of improving nurses' information about the associated complications with prolonged critical setting admission and standardized care, reflected on their attitudes, behaviors and their

practices when caring for children. The result matches with **Ismaiel, Talat, Ameen, & Abdelatef. (2022) & El-Feqi, Maarouf, & Ameen. (2023)** who demonstrated a prominent connection among knowledge and practices of nurses which is the way to achieve nursing competencies. Additionally, **Zhang et al. (2023)** who found a positive association between nurses' understanding and practice.

Conclusion:

According to the results of this study, it can be concluded that the application of educational intervention program had a beneficial effects on nurses' knowledge and practice regarding Post Intensive Care Syndrome and bundles of care for critically ill children.

Recommendations:

In the light of the results of this study, the subsequent recommendations were suggested:

- Written standard policies regarding ABCDEF bundle protocol for severely ill children should be available in every pediatric intensive care unit.
- Regular implementation of training programs for nurses about Post Intensive Care Syndrome should be taken place to enhance their performance.
- Routine monitoring of pain, sedation and delirium using validated tools.
- -Managers need to monitor regularly nurses, practice regarding care bundles for severely debilitating children.

Replication of the current study with a larger sample in different pediatric intensive care settings is required for generalizing the results.

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