

## The Effect of Chest Tube Instructional Package Application on Pediatric Nurses' Performance

Nadia Kasem Alaswad<sup>1</sup> & Nesren S. M. Bahnsawy<sup>2</sup>

<sup>1</sup>Lecturer of Pediatric Nursing, Faculty of Nursing, Cairo University, Egypt.

<sup>2</sup>Assistant Professor - Faculty of Nursing, Cairo University, Egypt.

### Abstract

**Background:** The role of the pediatric nurse in managing a chest tube in a pediatric child is vital for ensuring the child's safety, comfort, and optimal recovery. **Aim:** To evaluate the effect of chest tube instructional package application on pediatric nurses' performance. **Design:** One group pre-posttest quasi-experimental research design utilized to achieve the aim of the current study. **Setting:** The study was conducted in post-operative cardiac care and emergency units of Cairo University Specialized Pediatric Hospital (CUSPH). **Sample:** A convenient sample of 50 nurses who cared for children with chest tubes in the post-operative cardiac care unit and in the emergency unit. **Tools:** four tools were used to collect the required data a nurses' personal data tool, nurses' knowledge assessment tool, an observational checklist and the child's hospital stay tool. **Results:** the study revealed that there were statistically significant differences between total mean score of nurses' knowledge before and after application of the instructional package as well as nurses' practices mean score  $P$  value = 0.000. **Conclusion:** The study concluded that the instructional package has a significant impact on nurses' performance in caring for children with chest tubes. **Recommendations:** All nurses should be mandated by the Egyptian Ministry of Health to be certified by current instructional package about chest tube care. The credential should only be valid for one year, especially for nurses working in intensive care units.

**Keywords:** Chest tube, Instructional package, Nurses' performance & Pediatric nurses.

### Introduction:

Chest drainage involves the removal of air, water, blood, and other fluids from the pleural or mediastinal cavity by inserting a tube. It is commonly employed in the care of children who have undergone heart and chest surgery or experienced chest trauma (Porcel, 2018). A chest tube system is designed to restore the negative pressure within the pleural cavity by allowing the removal of accumulated blood, air, and fluid to the external environment (Seyma et al., 2021). The standard practice to use chest tubes to drain fluid, as well as prevent the buildup of air, blood, and other substances in the pleural space (Cheng et al., 2019).

Chest drainage may be necessary for various reasons, in thoracic surgery, it is utilized to re-inflate collapsed lungs, with the primary indication being pneumothorax. In cardiac surgery, chest tubes are routinely inserted as part of care to remove serosanguinous fluid from the mediastinal or pleural cavity, aiming to prevent complications such as cardiac tamponade (Tarhan et al., 2017).

Pneumothorax is prevalent in infancy, with a reported frequency of 9.1% in Cairo University Hospitals from September 2010 to August 2011. Another study conducted at Mansoura University Children's Hospital (MUCH) discovered that around 72 (36%) of the approximately 200 children who required chest

tube insertion due to various diagnoses between January 2018 and January 2019 were infants (Arafa et al., 2022).

Various complications can arise during the placement and removal of chest drains. The rate of complications associated with chest drain placement and management ranges from 5% to 35%. One of the most severe complications is tension pneumothorax, which can occur due to drainage system obstruction or Various complications can arise during the placement and removal of chest drains. The rate of complications associated with chest drain placement and management ranges from 5% to 35%. One of the most severe complications is tension pneumothorax, which can occur due to drainage system obstruction or during the removal process. Other complications include accidental removal or displacement of the tube and bleeding, all of which have the potential to endanger the child's life, increase morbidity, and prolong treatment (Abuejheisheh et al., 2021).

Tension pneumothorax is the most severe complication that can arise from chest tube placement, particularly when there is an obstruction in the drainage system. Other complications associated with chest tubes include bleeding from injury to the intercostal artery, perforation of visceral organs such as the lungs, heart, diaphragm, or intra-abdominal organs, perforation of vascular structures

like the aorta or subclavian vessels, intercostal neuralgia due to trauma to neurovascular bundles, subcutaneous emphysema, re-expansion pulmonary edema, infection at the drainage site, pneumonia, and empyema. Technical issues may also occur, such as intermittent tube blockage from clotted blood, pus, or debris, as well as incorrect positioning of the tube (Arafa et al., 2022).

The placement of chest tubes can lead to various negative effects, including pain, limited mobility, heightened infection risk, compromised ventilation capacity, and increased challenges in postoperative care, especially in children. These tubes not only cause discomfort for children but also result in longer hospital stays and higher medical expenses. As a result, there has been a growing interest in recent years to address issues related to chest tube placement following thoracic surgeries (Cheng et al., 2019).

In intensive care units (ICUs), nurses have a crucial responsibility in performing and overseeing various invasive procedures, including the insertion of chest drains. It is essential for nurses to have up-to-date knowledge on caring for children with chest drains (Abuejheisheh et al., 2021).

Adequate knowledge and experience among nurses in caring for children with chest tubes contribute to expediting children recovery, minimizing potentially life-threatening complications, enhancing child satisfaction, reducing hospital stays, preventing nosocomial infections, and lowering costs (Seyma et al., 2021). Nurses are responsible for monitoring children with chest tubes, identifying potential issues, and providing appropriate solutions. However, based on the findings of the study, it has been observed that nurses' knowledge level in managing children with chest tubes is insufficient (Tarhan et al., 2017).

Nursing care starting with comprehensive pulmonary assessment for children with chest drains is very important. In the context insertion site, dressing should be observed for any drainage, and the insertion site should be inspected for subcutaneous emphysema and tube migration. Attention should be given to ensure that no tubing is kinked or obstructed, and precautions should be taken to prevent fluid-filled dependent loops that may hinder drainage (Clinical key for nursing, 2023). Additionally, it can be divided into two phases: pre-procedural and post-procedural. In the pre-procedural phase, the nurse prepares the necessary equipment, ensures the child is in the correct position, verifies the administration of analgesia and sedation, explains the procedure to the child, and obtains informed consent (Abuejheisheh et al., 2021).

Nurses play a pivotal role in providing information and support to children and require sufficient knowledge and skills to deliver effective care while

working collaboratively with other healthcare professionals (Seyma et al., 2021). Furthermore, instructional package is an effective learning approach. It allows learners to study independently based on their specific needs and is particularly beneficial for acquiring and applying knowledge in cognitive and psychomotor domains. Instructional package often includes resources such as textbooks, scientific journals, and handout notes provided by teachers. They can serve as a foundation for introducing principles, providing step-by-step guidelines before demonstrating professional skills and enable learners to regularly evaluate their progress and receive immediate feedback (Mohammed & Farag, 2019).

### **Significance of the study:**

Limited evidence exists to guide chest tube management following cardiac surgery in children (Taylor et al., 2018). Chest drain insertion is frequently indicated to facilitate evacuation of air from the pleural space (Kagan et al., 2021). Pneumothorax is a common condition among children hospitalized in the Pediatric Intensive Care Unit (PICU). Therefore, the current study was performed in the post-operative cardiac care unit and the emergency unit in which nurses frequently deal with children with chest tubes.

Continuing education and training of nurses is the foundation for caring of pediatrics in PICU and emergency settings and provide nurses with new standards of performance to accurate performance on caring for children with chest tube to maintain competence and ensure safe and effective care provided to them. In Egypt there is a scarce of nursing studies, documented data regarding chest tube and related nursing care at the PICU or pediatric emergency departments. Through the clinical experience of research investigator notice that there is an incidence of complications related to chest tube in pediatrics and prolonged length of stay for those children. Hopefully this study will set a proper performance for nurses dealing with children with chest tube minimize the complications and shorten the length of stay and foster recovery raising quality of care provided and lower the burden of hospitalization.

### **Theoretical definition**

Nurse performance is defined as the action, attainment, or fulfillment of a nurse's obligations in relation to the tasks allocated to them. (Supri, et al 2019)

### **Operational definition**

Pediatric nurse performance is defined as "their knowledge and practices in caring for pediatric

children with chest tubes implementing the instructional package."

**Aim of study:**

The study aims to evaluate the effect of chest tube instructional package application on pediatric nurses' performance.

**Research hypotheses:**

**H1:** Nurses who receive the instructional package will have a higher mean score of knowledge than before.

**H2:** Nurses who receive the instructional package will have higher mean score of practice than before."

**H3:** The child's hospital stay will be shorter after the nurses receive the instructional package.

**Research design:**

One group pre-posttest quasi-experimental research design was utilized to achieve the aim of the current study. A quasi-experimental design is one type of experimental design that is very similar to the true experimental design except it lacks one criterion as randomization or control (Gray et al., 2019).

**Sample:**

The study comprised all nurses working in the post-operative cardiac care unit and emergency unit at Cairo University Specialized Pediatric Hospital (CUSPH). There were 50 nurses.

**Setting:**

The study was conducted at CUSPH on the first floor of the pediatric emergency unit which is composed of 20 beds with nursing staff, 25 nurses of both gender and at 5<sup>th</sup> floor post-operative cardiac care unit composed of 16 beds with 25 member of nursing staff.

**Data collection tools:**

**I. Nurses' personal data tool:** It was developed by researchers, and it involves personal data about the nurses (age, gender, level of education, years of experience, and place of residence).

**II. Knowledge assessment tool:** The researchers created 18 multiple choice questions after reviewing the associated literatures on chest tube care, split into four main parts: the first part regarding basic knowledge about the child's chest tube consists of seven questions on anatomy and physiology of the respiratory system, the second part about chest tube insertion consists of four questions. The third section has four questions concerning chest tube problems and complications. The fourth section comprises of three questions regarding nursing care in case of problems.

**Scoring system:**

The pre-posttest used a scoring system for nurses' knowledge that consisted of 18 scores, which translated to 100 percentage marks. Each correct response received one mark, while incorrect answers or no response received zero mark. The overall score

was converted to 100% (18 marks), then divided into three categories: high, (85 - 100), moderate (65 < 85), and low. (< 65), (Christiana et al., 2020).

**III. Observational checklist:** After reviewing the relevant literature and chest tube care competencies, the researchers created an observation check to assess pediatric nurses' practice regarding chest tube care. It consisted of 18 steps, separated into three major parts " pre procedure and contained 8 steps, procedure included 9 steps, and post-procedure included one item". (clinical key for nursing 2023).

**Scoring system:**

The scoring system for nurses' practices, each done correct step receives a "1" score, whereas each incorrect or not done step receives a "0" score. After multiplying the total score by 100% (18 points), it was divided into two categories: less than 60% referred to unsatisfactory, and more than 60% referred to satisfactory (Ibrahim et al., 2021).

**IV. The Child's Hospital Stay tool:** It developed by the researchers to assess the length of hospital stay for children with chest tubes at the unit one month before starting the instruction package and one month after the posttest as an indicator of nurses' performance after receiving the instructional package. The recording child's stay tool only contains two items: child diagnosis and days of hospital stay (from chest tube insertion to discharge from units).

**Pilot study**

A pilot study was done on 5 nurses to determine the time required to complete the tools. Minor changes were implemented. The pilot study was eliminated from the whole study sample.

**Data collection procedure:**

An official permission from CUSPH was obtained. Nurses who work in the cardiothoracic care unit were invited to participate in the study. The purpose and the nature of study explained to each nurse individually or in a group of 2-3 nurses at a time. A consent obtained from each nurse to get acceptance and cooperation. The same was done with nurses in the emergency unit.

**Pre implementation phase**

The interview was conducted for all nurses to fill structured interview questionnaire (tool I) which covered personal and professional data about nurses: age, level of education, occupation, experience in years, and place of residence. Then, the researchers obtained nurses' knowledge about chest tube care (tool II) regarding to care, risk signs, interventions, and applications as pretest, as well as the researchers checked nurses' practice as pretest for chest tube care using the observational checklist tool III while nurses providing the care for chest tube. In the same context the researchers recorded the length of hospital stay

using tool IV one month before starting the instruction package.

### **Implementation phase**

The researchers began to apply the package to the nurses who had completed the pretest. The researchers used pictures and flyers to facilitate and simplify the knowledge, and they provided nurses the opportunity to answer all of their questions. This session lasted around 20 - 30 minutes and was held in the break room of the post-operative cardiac care unit on the fifth floor and the emergency unit on the first floor.

For practice, the researchers gathered 2-3 nurses and demonstrated the chest tube procedure. In front of the nurses, the researchers attempt to explain the techniques and provide justification for each step. The redemonstration takes approximately 5-7 minutes for each nurse. In addition to YouTube video explaining chest tube and related nursing care was sent to them via what's application.

### **Post implementation phase**

After a week from receiving the structured package, the researchers conducted posttest for nurses used (tool II) as a posttest time for test took 15- 20 minute for each nurse. As well as using the observational checklist to evaluate the nurse's practices, post instruction takes approximately 5-7 minutes for each nurse. The length of hospital stay of children with chest tubes at the unit was checked by the researchers monitoring the child's stay (tool VI) following month from the posttest as an indicator for nurses' performance after receiving the instructional package.

### **Validity and reliability:**

The researchers created the data collection tools after conducting a thorough review of recent literature. To ensure the content validity of the tools, a panel of five experts in pediatric nursing evaluated its content. Based on the panel's feedback regarding sentence clarity, content appropriateness, and item sequence, the tools were modified accordingly.

To assess the degree to which the items in the tools measure the same concept and are interrelated, the internal consistency was evaluated. Internal consistency examines the reliability of a questionnaire by grouping questions that measure the same concept. Cronbach's alpha is a commonly used method to compute the correlation value among the questionnaire items. In terms of the reliability of this study's tool, the coefficient alpha of the questionnaire tool was determined to be 0.65.

### **Ethical considerations:**

### **Results:**

Approval was acquired from the research ethics committee at Cairo University's Faculty of Nursing .on July 24th, 2023, with reference number FWA00026458. The nurses were provided with a detailed explanation of the study's purpose and nature, and written informed consent was obtained from them. It was made clear to the nurses that their participation in the study is voluntary and that they have the freedom to withdraw at any point without providing a justification. The confidentiality of each nurse was guaranteed.

### **Statistical analysis:**

A suitable PC is utilized to store and analyze data. The Statistical Package for Social Studies (SPSS), specifically version 21.0, is employed for this purpose. Data is coded and summarized using various statistical measures such as mean, standard deviation, crosstabs for quantitative variables, and percent for qualitative variables. Paired-sample t-test was used to compare means. Pearson correlation coefficient is utilized to determine correlation among variables. The level of significance is set at  $p < 0.05$ , which serves as the threshold for statistical significance.

**Table (1): Percentage distribution of nurses' personal data n= 50**

Personal data	No	%
<b>Age</b>		
20<24	25	50
24<28	17	34
28-31	8	16
Mean ± SD	24.34 ± 2.47	
<b>Gender</b>		
Male	36	72
Female	14	28
<b>Education degree in nursing</b>		
Technical nursing institute	0	0
Bachelor	18	36
	32	64
<b>Residence</b>		
Urban	27	54
Rural	23	46
<b>Years of experience</b>		
1<3 years	30	60
3<6 years	15	30
6-9 years	5	10
Mean ± SD	2.40 ± 2.04	
<b>Attending a chest tube education training</b>		
Yes	0	0
No	50	100

**Table (2): Percentage distribution of nurses' knowledge in the pre and post instructional package application n= 50**

Items	Pre-instructional package				Post-instructional package			
	Correct		Incorrect		Correct		Incorrect	
	No	%	No	%	No	%	No	%
<b>Basic information</b>								
- The anatomical structure of the respiratory system	12	24	38	76	44	88	6	12
- The function of the respiratory system	5	10	45	90	38	76	12	24
- The pleural cavity pressure (negative or positive)	21	42	29	58	38	76	12	24
- The components of the pleural cavity	9	18	41	82	39	78	11	22
- The main function of insertion the chest tube	14	28	36	72	49	98	1	2
- The chest tube made of silicone or plastic,	7	14	43	86	11	22	39	78
- The chest tube is placed in the middle of the child's lung	15	30	35	70	43	86	7	14
<b>Insertion of the Chest tube</b>								
- The child is placed on the unaffected side of the chest during the insertion	33	66	17	34	50	100	0	0
- The rate of water in the container of fluid collection should not be less than 10cm above the level of the chest tube	29	58	21	42	39	78	11	22
- The container to collect fluids in the chest tube is filled with normal saline solution	28	56	22	44	37	74	13	26
- The date and time of the chest tube insertion should be monitored	10	20	40	80	40	80	10	20
<b>Problems and Complication</b>								
- What are the complications of the chest tube.	8	16	42	84	41	82	9	18
- Change the fluid texture in the fluid collection container from liquid to cream indicates infection.	40	80	10	20	44	88	6	12
- Excessive secretions in the fluid collection container indicate an infection.	27	54	23	46	45	90	5	10
- The container for fluid collection should be raised to a higher level than the child.	8	16	42	84	36	72	14	28
<b>Nursing Care in case of problem</b>	24	48	26	52	39	78	11	22
- The child removed the tube suddenly.								
- Breaking the fluid collection bottle,	17	34	33	66	39	78	11	22
- The chest tube is blocked by blood clots or pus	28	56	22	44	29	58	21	42

**Table (3): Comparison between total levels of nurses' knowledge regarding care of the chest tube in the pre- and post- instructional package application. n=50**

Levels	Pre-instructional package		Post-instructional package		t	p
	NO	%	NO	%		
High	0	0	12	24.0	20.079	0.000*
Moderate	0	0	35	70.0		
Low	50	100	3	6.0		
Mean $\pm$ SD	7.50 $\pm$ 2.66		16.22 $\pm$ 2.04			

**Table (4): Percentage distribution of nurses' practice related to care of chest tube n=50**

Items	Pre-instructional package				Post-instructional package				
	Done correct		Not done or incorrect		Done correct		Not done or incorrect		
	No	%	No	%	No	%	No	%	
<b>Pre-procedure steps</b>									
- Identify the child	50	100	0	0	50	100	0	0	
- Perform hands washing	16	32	34	68	37	74	13	16	
- Prepare all equipment	16	32	34	68	38	76	12	24	
- Reassurance the child	10	20	40	80	37	74	13	16	
- Keep privacy	0	0	50	100	24	48	26	52	
- Place the child in comfortable position	23	46	27	54	40	80	10	20	
- Wearing a sterile glove	17	34	33	66	31	62	19	38	
- Monitor vital signs and Check oxygen saturation	37	74	13	26	26	52	24	48	
<b>Procedure steps</b>									
- Assess insertion site and surrounding skin.	0	0	50	100	29	58	21	42	
- Check that the tube is still in the chest	2	4	48	96	38	76	12	24	
- Check connection between chest tube and system	18	36	32	64	39	78	11	22	
- Assessing the drainage system every 2 to 4 hours.	50	100	0	0	50	100	0	0	
- Check that all connections are properly wrapped and tight.	1	2	49	98	20	40	30	60	
- Ensure that there are no kinks or dependent loops in the drainage tube.	24	48	26	52	32	64	18	36	
- Adjust tubing to hang in a straight line from the chest tube to drainage chamber.	30	60	20	40	50	100	0	0	
- Observe the water-seal chamber for fluctuations of water level with the child's respiration	33	66	17	34	50	100	0	0	
- Assess for air leaks in then system, as indicated by constant the bubbling in the water-seal bottle or chamber.	10	20	40	80	50	100	0	0	
<b>Post-procedure steps</b>									
- Documentation of date, time, and any abnormal findings	0	0	50	100	49	98	1	2	

**Table (5): Comparison between total levels of nurses' practices regarding care of the chest tube in the pre- and post- instructional package. n=50**

	Pretest-instructional package		Post-test- instructional package		test of significance	P value
	N	%	N	%		
Satisfactory	0	0	26	52	T=-16.689	0.000*
Unsatisfactory	50	100	24	48		
Mean $\pm$ SD	7.68 $\pm$ 2.13		14.42 $\pm$ 1.85			

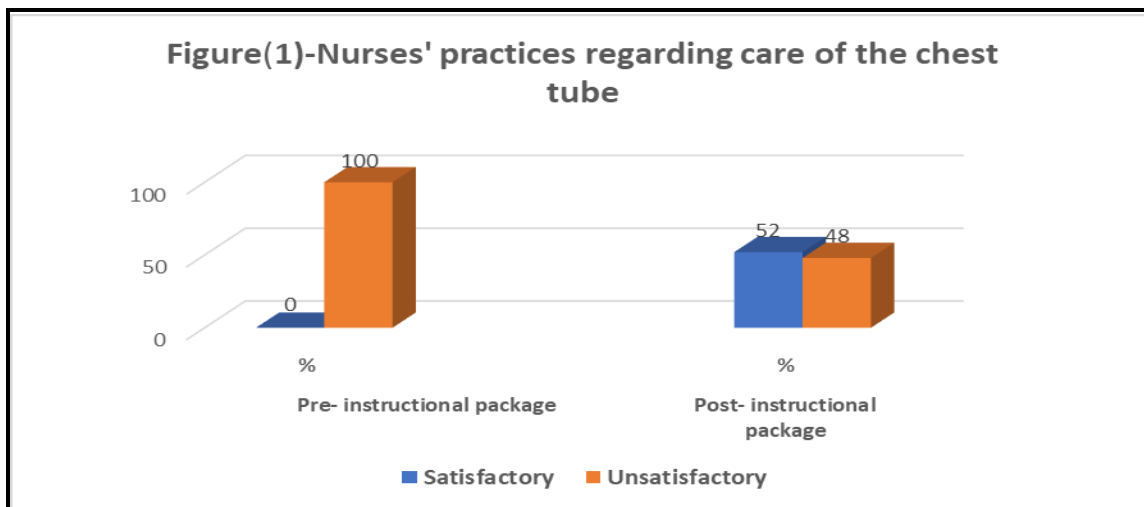


Figure (1): Nurses' practices regarding care of the chest tube

Table (6): Length of hospital stay of children with chest tube at ICU one-month pre and post instructional package.

Item	One month Pre instructional package n=15				One month post instructional package n=15				Test	
	5<10 days		10- 15 days		5<10 days		10-15 days		t	P value
	No	%	No	%	No	%	No	%		
<b>Children Diagnosis</b>										
VSD repair	2	13.3	2	13.3	3	26.7	1	6.7	.689	.502
ASD repair	2	13.3	2	13.3	2	13.3	2	13.3		
PDA repair	1	6.7	3	26.7	1	6.7	3	26.7		
TOF repair	0	0	2	13.3	0	0	3	26.7		
ASO repair	0	0	1	6.7	0	0	0	0		
Mean +SD	11.6 ± 2.53				11.07 + 3.17					

VSD= Ventricular septal defect, ASD= Atrial Septal Defect, TOF=Tetralogy of Fallot, ASO=Arterial switch operation.

Table (7): Correlation between nurses' personal data and overall means scores of knowledges and practices after instructional package application.

Item	Overall mean score 'knowledge		Overall mean score practice	
	r	P	r	P
Age	.117	.417	.089	.541
Years of experience	.278	.050*	.036	.806
Attending a chest tube raining	.063	.666	.298	.035*

**Table (1):** Illustrated that 50 % of nurses' their age ranged from 20<24years old, while 34 % of them their age ranged from 24<28with mean ± SD (24.34 ± 2.47). Regarding gender 72 % of nurses were males while 28 % of them were females. Concerning education 64% of nurses graduated from the university while 36 % of them graduated from institute of nursing. As for residence 54% of nurses from the urban areas while 46 % of them were from the rural areas. 60 % of nurses had 1<3 years of experience and 30 % of them had 3<6 years with mean ± SD (2.40 ± 2.04). 100% of the nurses did not receive any form of chest tube education training.

**Table (2):** Showed that most nurses after application of the instruction package had a correct response about the fundamental understanding of chest tube

(function, characteristic of tube and placing, insertion) While only one quarter of them still had incorrect response regarding the system and mechanism of the pleural cavity and its components. As well as for chest tube problems and complications nearly one-quarter and 42% of them after application of the instruction package still had incorrect responses regarding the container for fluid collection and nursing care in case of the child's chest tube being blocked by blood colts or pus, respectively.

**Table (3):** Illustrated that 100 % of nurses had a low level of knowledge before application of instructional package while 70% of them had moderate level and 24% of them had high level of knowledge after application of the instructional package. As well as there was a statistically significance difference

between nurses' scores before with mean + SD=7.50  $\pm$  2.66 and after application of the instructional package with mean + SD =16.22  $\pm$  2.04. P- value = 0.000.

**Table (4):** Reported that the nurses' practice regarding care of the chest tube, pre and post implementation of chest tube instructional package, the majority of nurses demonstrated correct practice regarding the care of children with chest tubes. While during pre-procedure steps still nearly half of nurses (48%) not done or incorrect monitor the children ' vital sings and oxygen saturation as well as more than half of the nurses (52%) performed incorrectly in the care of children with chest tubes in terms of maintaining privacy. Additionally, in procedure steps more than half 60% performed incorrectly in the care of children with chest tubes in terms of ensuring that all connections are securely taped and tight while performing the skills, nearly 42% of them did not check and assess the insertion site and surrounding skin for signs of infection, inflammation, swelling, or pain.

**Table (5):** Documented that the nurses' practice improved significantly after application of the instructional package related to chest tube care than before (7.68  $\pm$  2.13 and 14.42  $\pm$  1.85, respectively), and there was statistically significant difference P-value =0.000.

**Figure (1):** Highlighted that all nurses' scores confirmed unsatisfactory practices before the instruction package, while more than half scored satisfactory after the application of the instruction package.

**Table (6):** Showed that the mean length of hospital stays of children with chest tubes at ICU one-month pre and one month post instructional package was nearly the same (11.6 + 2.53 and 11.07 + 3.17, respectively), indicating that there was no statistically significant difference in length of hospital stay in children with chest tubes before and after application of the instructional package (t =.689, P =.502).

**Table (7):** Showed that there was no statistically significant correlation between the overall mean score of nurses' knowledge and practice and their age. However, there was statistically significant positive correlation between the overall mean score of nurses' knowledge and years of experience as well as overall mean score of nurses' practices and attending a chest tube training.

## Discussion

Professional pediatric nurses with the requisite knowledge and competence can minimize serious complications and provide the best results for the child with a chest tube. The efficacy of any educational intervention is dependent on each

member of the medical team understanding the anatomy of the chest, where to place the tube, understanding these devices' mechanical functions as well as their drainage system, so the main aim of the current study was to evaluate the effect of chest tube instructional package application on pediatric nurses' knowledge and practice.

Regarding the personal characteristics of the participants the current study reported that half of nurses' age ranged from 20 < 24 years old, with mean (24.34  $\pm$  2.47), nearly three quarters of nurses were males, these results were supported by many researchers who explore effectiveness of educational programs on nurses' knowledge's regarding chest tube and its complication as documented in a study of **Patidar, et al., (2021) & Hassan et al, (2021)**. In addition, this finding was inconsistent with those obtained by **Mohamed, et al., (2023)** who reported in their study that the majority of nurses were females. In the same context the present study revealed that most nurses had bachelor's degree and the majority of nurses had 1<3 years of experience with mean (2.40 + 2.04), also there was a statistically significant positive correlation between the overall mean score of nurses' knowledge and years of experience this finding supported by **Anjum, (2020)**. But these finding contradicted by **Mohamed, et al., (2023)** who reported in their study that the most of nurses were females and graduated from nursing technical institute as well as there was strong relation between years of experience and nurses' knowledge. Most of authors in all published articles regarding nurses' knowledge and practice foster and documented that, the years of experience and degree of education have great influence on the care provided to the child in any field and particularly critically ill children admitted to the PICU.

Concerning attending an education program the current study revealed that all the nurses did not receive any form of chest tube education training. This results in agreement with **Mohamed, et al., (2023) & Hassan et al, (2021)**. The researchers associate the nurses' year of experience with attending education program as a rationale, the mean of experience nearly 2.4 years, so there is insufficient time to have any education program that is the primary cause of did not attend any education program.

Regarding nurses' knowledge the current study examined the primary items to assess the nurses' knowledge, for the basic information including anatomy and physiology of the respiratory system, The most nurses after application of the instructional package had a correct response about the fundamental understanding of chest tube (function, characteristic of tube and placing, insertion) the



researchers documented that the nurses had enhancement in percentage after the application of instructional package. While only one quarter of them still had incorrect response regarding the system and mechanism of the pleural cavity and its components. This result is consistent with **Elsaoudy, et al., (2022)**. Who assessed the nurses' knowledge and practice regarding care of chest tube and reported the same conclusion. The researchers explained and connected this finding to the fact that none of the nurses had taken part in any educational programs and that the unit had no manuals, handouts, or protocols for caring for children with chest tubes. This explanation was consistent with **Ibrahim & Elshemy, (2020)** and **Ibrahim (2018)**, who reported in their study about the effect of nurses' education program to provide care to the children with chest tube they reported that education program should be mandatory to any pediatric nurse caring for chest tube.

In the same context regarding nurses knowledge for chest tube problems and complications the current study in the table 2 documented that nearly one-quarter and forty two of them after application of the instructional package still had incorrect responses regarding the container for fluid collection and nursing care in case of the child's chest tube being blocked by blood clots or pus, respectively, the researchers explained to all nurses the importance of raising the container for fluid collection to a higher level than the child, as well as how to provide care in case of the child's chest tube being blocked by blood clots or pus, respectively. This finding is congruent with the findings of **Elsaoudy, et al., (2022)**, who discovered that nurses require ongoing training and feedback regarding nursing care delivered to children with chest tubes.

The current study highlighted that all nurses had a low level of knowledge prior to the application of instructional package, while seventy percent of them had a moderate level of knowledge and nearly one fourth of them had a high level following the application of the instructional package. There was also a statistically significant difference in nurses' scores before and after the implementation of instructional package. These findings supported hypothesis (H1) of the present study. These findings agreed also with those of **Kouser et al., (2023)**; **Mohamed, et al., (2023)** & **Queiroz, et al., (2022)**. Who conducted a study to evaluate the effect of chest tube guidelines on nurses' knowledge, they discovered that the nurses had sufficient and moderate knowledge level regarding management of children with chest tubes. And there was a statistical significant differences before and after the intervention.

Concerning the nurses' practices regarding care of

chest tube following the implementation of instructional package related to chest tube, the majority of nurses demonstrated correct practice of skills regarding the care of children with chest tubes. While more than half of the nurses performed incorrectly in the care of children with chest tubes in terms of maintaining privacy and ensuring that all connections are securely taped and tight while performing the skills, forty-two of them did not check and assess the insertion site and surrounding skin for signs of infection, inflammation, swelling, or pain. These findings were consistent with **Elsaoudy, et al., (2022)**.

According to the current study, nurses' practices improved significantly after application of the instructional package related to care of chest tube compared to before ( $7.68 \pm 2.13$  and  $14.42 \pm 1.85$ , respectively), with statistically significant difference p-value 0.000. These findings supported the hypothesis (H2) of the current study. These findings matched with those of **Kouser, et al., (2023)**; **Mohamed, et al., (2021)**; & **Queiroz et al., (2022)**.

The current study showed that the mean length of hospital stays of children with chest tubes at ICU one-month pre and post instructional package was nearly the same ( $11.6 + 2.53$  and  $11.07 + 3.17$ , respectively), indicating that there was no statistically significant difference in length of hospital stay in children with chest tubes before and after application of the instructional package. This finding did not support the hypothesis (H3) of the current study, in the same context **Hart, et al., (2023)** demonstrated in their study on single chest tube versus double chest tube application that various factors influence hospital stay. The researchers noted that the parameters depend on a variety of factors such as the child's age, diagnosis, and health status, as well as the child's immune system and whether the child has a single or double chest tube.

### Conclusion:

The study concluded that nurses who got the instructional package had higher levels in their performance (knowledge and practice) than they did prior to its application, revealing that the instructional package has a significant impact on nurses' capability in caring for children with chest tubes.

### Recommendations

Based on the current study findings the researchers recommended the following.

- 1- All nurses should be mandated by the Egyptian Ministry of Health to be certified by current instructional package about chest tube. The credential should only be valid for one year, especially for nurses working in intensive care units.

- 2- Producing handbooks, pamphlets, and brochures to update nursing procedures and details on chest tube care.
- 3- To generalize the results, the study should be repeated with additional nurses and in various settings in order to gather quantifiable data on the nurses' performance in caring for children with chest tubes.

#### Conflict of interest:

The authors would like to declare that there is no conflict of interest in this situation. All individuals involved in this research have no personal or financial interests that could potentially influence the objectivity, integrity, or impartiality of the study. Our primary focus is to conduct a rigorous and unbiased investigation, ensuring the validity and reliability of the research findings. We are committed to upholding the highest standards of ethical conduct, transparency, and integrity throughout the entire research process.

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