

## Effectiveness of an Educational Program Regarding Care of Infants with Chest Tube on Nurses' Knowledge and Practice



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### 1. ABSTRACT

**Background:** Chest tube is a widely applied postoperative treatment of the respiratory and cardiothoracic problems. A chest tube can be a life-saving intervention for infants suffering from a pneumothorax, bloody effusion and hemothorax. However, it is associated with significant morbidity and mortality. **Aim:** this study aimed to evaluate the effectiveness of an educational program regarding care of infants with chest tube on nurses' knowledge and practice. **Method:** A quasi-experimental research design was conducted on a sample of 50 nurses worked at pediatric surgical & cardiothoracic intensive care units (PCICU) of Mansoura University Children's Hospital (MUCH). **Tools:** A Structured Questionnaire Sheet for nurses' knowledge & nurses' practice for caring for infants with chest tube observational checklist. **Results:** the majority of the studied nurses had good knowledge and most of them had competent practice after implementation of an educational program with a highly statistically significant difference. **Conclusion:** There was an improvement in the nurses' knowledge and practice after implementation of the educational program. **Recommendations:** In-services, up to date and regular training programs to improve nurses' knowledge and practices regarding care of infants with chest tube. Further studies are recommended to repeat this study on a large sample size and on a wide scale in various governorates of Egypt.

**Keywords:** Chest tube, Infants, Educational program, Nurses, Knowledge, Practice

### 2. Introduction:

A chest tube is a hollow flexible tube inserted into the pleural cavity, it is found between a chest wall and lungs. It is an invasive procedure used for evacuation of the accumulated fluid, air, and blood from the pleural cavity. It also acts as a pathway to instill medications as becoming the first line of analgesic treatment to relieve the pain of the infant suffering from malignant and persistent benign pleural effusions (Patidar, Patidar & Patel, 2021).

Hence, the chest tube is very important as it is used with the infant who has a pneumothorax, hemothorax, pleural effusion, empyema, and also chylothorax. It's used with cardiothoracic surgery to permit re-expansion of the lung and for restoring normal ventilation. Chest tube also used to maintain sub-atmospheric pressure (Diaz, Patel, Almeida & Shekar et al., 2020).

On the other hand, it also considers a life-threatening procedure as it may leads to tension pneumothorax as a result of malposition of a chest tube, bleeding due to injury to the great vessels, subcutaneous emphysema, infection at the site of insertion, pain, and shortness of breath. These can be decreased by awareness of the anatomy of the chest of the infant, site of insertion, and the use of the minimum pressure required during insertion.

So, complications can result due to a lack of knowledge and practice of the health care team (Panza, Prontera, Ives & Zivanovic et al., 2020).

Therefore, it may lead to morbidity, mortality and increase the risk of complications. Therefore, the nurse should have well practice about chest tube care and have knowledge about indication, placement, removal, procedures, and complications of a chest tube to provide high quality and effective health care for the infant. The responsibility of a pediatric nurse is extremely important to include before, during, after, as well as the removal of a chest tube (Hamad & Alfeky, 2021).

Nurse is the first one to provide care of the infant with a chest tube. Nurses with adequate awareness and experience can reduce serious complications and provide optimal outcomes for the infant with a chest tube. Every member in the medical team should have knowledge about the anatomy of the chest, positioning of the tube, and standard implementation are essential for the success of this treatment, therefore medical and nursing staff in general must be trained (Salime, Abd EL-Aziz, Al Metyazidy & Weheida, 2021)

### Significance of the study:

Pneumothorax is a life-threatening between infants and approximately 183 neonates (age  $\leq$  28 days) are hospitalized between January 1- 2015 and December 31- 2018 for pneumothorax or developed pneumothorax within the Children's Hospital of Soochow University that needs the insertion of a chest tube for drainage and improves the result of the infants (Tan, Zhan, Geng&Chen et al.,2020). Pleural effusion (benign, malignant) as in the study of Spanish population the incidence of infectious pleural effusion in children younger than five years increased from 1.7 per 100.000 in 1999 to 8.5 per 100.000 in 2004, the empyema as in the United States the empyema associated hospitalization rate has increased from 2.2 per 100.000 in 1997 to 3.7 per 100.000 infant in 2006 (Afsharpaiman, Izadi, Ajudani&Khosravi, 2016).

Chylothorax the recent evidence indicates a high incidence chylothorax for children and 9.2 per cent in infants as one way of management is insert a chest tube (Weissler,Cho, Koltz&Carney, et al., 2018).Unfortunately, in Egypt, there is little documented data regarding a chest tube of infants. Research about nurses' knowledge and practice regarding care of infants with chest tube are lacking. Pneumothorax occurs frequently in infancy period and the incidence is 9.1% in Cairo University Hospitals over one year from September 2010 - August 2011 (Abdellatif & Abdellatif, 2012). According to statistical office in Mansoura University Children's Hospital (MUCH) found that, from January 2018 to January 2019 about 200children with different diagnosis insert chest tube, almost 72cases of them are infants (36%). So, the aim of this study is to study the effect of program implementing about care of infant with chest tube on nurses' knowledge, and practice.

### Aim of the study:

Evaluate the effectiveness of an educational program regarding care of infants with chest tube on nurses' knowledge and practice.

### Research hypothesis:

- Nurses' knowledge regarding care of infants with chest tube may be improved after implementation of the educational program.
- Nurses' practice regarding care of infants with chest tube may be improved after implementation of the educational program.

### 3. Subjects and Method:

#### 3.1. Research design

A quasi-experimental design. This type of design is an empirical study used to estimate the effect of an intervention on its target population without random assignment (Densie & Tanto, 2014).

#### 3.2. Study Setting

The study was carried out at the surgical and cardiothoracic intensive care units affiliated to Mansoura University Children's Hospital (MUCH), in Mansoura city, Dakahlia governorate, surgical intensive care units located at the third floor and consisted of two ICUs. One of them has seven incubators, and the other has four beds. While, cardiothoracic ICU located at the seventh floor and consisted of two intensive care units, one of them has two incubators and four beds, and the other has four beds.

#### 3.3. Subjects:

A convenience sample of 50 nurses of both sexes who are working in pediatric surgical and cardiothoracic intensive care units, regardless their age, qualifications and years of experiences who provide nursing care of infants with chest tube and willing to participate in this study were included.

#### 3.4. Tools of Data collection tools:

##### Tool I: Structured Questionnaire Sheet (Pre & Immediate Post Format):

The researcher prepared it after reviewing the relevant literature related to the study to assess nurses' knowledge about care of infants with chest tube. It composed of (40) questions divided in three parts:

##### a) Demographic Characteristics of the Studied Nurses

Which composed of (7) questions covered the following items: age, sex, level of education, years of experience, workplace and chance for attending training courses about care of chest tube. It was used only once in the beginning of the study as a baseline data of the study subjects.

##### b) Nurses' knowledge regarding chest tube drainage

It composed of (12) questions about the chest tube made from, the pressure in the pleural cavity, site of pressure in the pleural cavity, size of chest tube, uses, indications, complications of chest tube, indications of bubbles on the surface of the chest tube, chest tube bottle system, components of

the chest tube bottle system and uses of drainage system and expectation of nurse about emphysema.

### **c) Nurses' Practical Knowledge Regarding Care of Infants with Chest Tube**

It composed of (21) questions covered the following items: position of the infant during the insertion of the chest tube, insertion site of chest tube, the role of the nurse after insertion of the chest tube, the routine care of chest tube for infants, changing bottle of chest tube, role of the nurse (during the transportation of the infant with chest tube to another place, time of chest tube removal and role of nurse after removing the chest tube for infants.

#### **Scoring system:**

Scoring system was graded according to the items of interviewing questionnaire; the answers of the nurses were evaluated by using model key answer prepared by the researcher. Nurses' knowledge was scored two for each correct answer, one for incomplete answer and zero for incorrect or missed answer. There were some questions that nurses can choose more than one answer. The total knowledge score (theoretical and practical knowledge) was (66) marks.

#### **The knowledge level was classified into three categories (Abdel Salam & El Shemy, 2016).**

- Good knowledge score: > 75% (> 49.5 marks).
- Average knowledge score: 50-75% (33- 49.5 marks).
- Poor knowledge score : <50% (< 33 marks).

#### **Tool II: Nurses' Practice for Caring for Infants with Chest Tube Observational Checklist**

This tool was adopted from Dobra et al., (2001), Jacob et al., (2007), and Shaker, (2011) and was modified by the researcher. It was used twice, one of them in the beginning of the study (**pre-test**) and the other after the educational sessions (**post-test**) which provided through the researcher who filled it to evaluate nurses' practice for caring for infants with chest tube. It consisted of 4 sub main parts such as: : Before insertion of chest tube procedure (14 sub items), During insertion of chest tube procedure (7 sub items), After insertion of chest tube procedure (7sub items), and Removal of chest tube procedure (19 sub items).

#### **Scoring system:**

Nurses' practice was scored two for each step done completely correct, while step done incompletely correct was given a score of one and zero was given for not done step. The total score of the studied nurses' practice was (172) marks.

#### **The nurses' practical level was classified into two categories (Abdel Salam & El Shemy, 2016)**

- Incompetent practice score: <75% (<129 marks).
- Competent practice score: ≥75% (129 -172 marks).

### **3.5. Method**

#### **1. The preparatory phase**

This phase included a review of the past and current related literature and studies, using available books, periodicals, magazines and articles to be acquainted with the various aspects of the study and develop the study tools. Five nursing experts in the field of the study assessed and revised the content validity of the study tools. The internal consistency of the study tools was tested by using Cronbach's alpha coefficient test  $r = 0.832$  for tool I (Part A= 0.59, B= 0.88 & C= 0.78),  $r = 0.82$  for tool II.

#### **3.6. Ethical consideration:**

An informed oral consent was obtained from each nurse for her participation after explanation of the purpose of the study. Anonymity and confidentiality of collected data were assured and used only for research purposes. Participants were informed that participation in the study is voluntary, and they have the right to withdraw from the study at any time freely without any responsibilities.

### **2-Exploratoryphase**

#### **Pilot study**

A pilot study was conducted on 10% of the total sample size (5 nurses) who were selected randomly from the same setting to evaluate the clarity, feasibility and applicability of the study tools, identify the possible obstacles that may hinder data collection and the overcome measures. The pilot study based on the subjects of the study total sample because there were no significant modifications required in the study tools.

### Fieldwork:

Data collection extended over a period of six months from the first of November 2019 to the end of April 2020. At first, the researcher introduces herself to the nurses, then gives them a concise idea of the aim and nature of the study. The researcher attended two days per week in the study setting from 9.00 am to 4.00 pm. The studied nurses were divided into (6\_8) groups; each one was consisted of approximately 6 nurses. The researcher used different teaching methods as group discussion, and electronic brainstorming such as (video conference), demonstration and re-demonstration. Numerous didactic aids were used, such booklet and power point. The researcher observes nurses' practices pre and post implementation of the educational program in the morning and afternoon shifts.

### Administrative design

An Official approval was obtained from the Research Ethics Committee of Mansoura Faculty of Nursing to carry out the study. A letter was submitted from the researcher to the Director of MUCH to obtain a permission to conduct the study.

### 3.7. Statistical analysis

The collected data were coded and entered to the statistical package of social sciences (SPSS) version 18. After complete entry, data were explored for detecting any error, and then it absolutely was analyzed by the identical program for presenting frequency tables with percentages. Qualitative data was presented as number and percent. Paired sample t-test was conducted to indicate whether the difference between sample averages is likely to represent an actual difference between target group knowledge, practical knowledge and practice averages before and immediately after application of the educational sessions. Person and spearman correlation ( $r$ ) was performed to measure the strength of a linear relationship between quantitative and qualitative variables. The Chi-Square or fisher's exact test ( $\chi^2$ ) was used to check whether the variables are independent of each other or not. Quantitative data were described as mean  $\pm$  SD as appropriate. They were tested for normality by Kolmogorov-Smirnov test. For all the statistical tests mentioned above the threshold of significance is set at a level of 5% (P-

value); the results were considered not significant ( $P > 0.05$ ), significant ( $P \leq 0.05$ ), and highly significant ( $P < 0.001$ ).

### 4. Results:

**Table (1)** showed that 54% of the studied nurses aged from 30 to 45 years with the mean age of  $30.1 \pm 7.88$ . The majority of the studied nurses (80%) were females, 56% of them were bachelor's degree. This table also illustrated that 62% of the studied nurses were one to less than ten years of experience with the mean experience of  $6.94 \pm 3.40$  years; nearly three quarters of them (72%) were working at surgical ICU. In relation to the job title of the studied nurses, half of them (50%) were head nurse and nearly three quarters of them (72%) not attending the previous training program.

**Table (2)** proved that, about two thirds (66%) of the studied nurses had poor total knowledge about chest tube care before implementation of educational program, which increased to become 80% good total knowledge after the program implementation with statistically significant difference ( $p=0.073$ ).

**Table (3)** it was indicated that, the mean score of the studied nurses' total practice about care of infants with chest tube before implementation of educational program was  $78.46 \pm 19.73$ , which increased to  $140.5 \pm 12.41$  immediately after program implementation with highly statistically significant difference ( $p=0.000$ ). Additionally, there was a highly statistically significant improvement before and after program implementation, regarding the studied nurses' practice (before, during, after) insertion of a chest tube, daily routine care, changing dressing, changing drainage bottle and removal of chest tube.

**Table (4)** interpreted that, 100% of the studied nurses had incompetent practices pre - program implementation, which markedly decreased to 10% post program implementation, with highly statistically significant difference ( $p = 0.000$ ).

**Figure (1)** regarding to correlation between total scores of the nurses' level of knowledge and practice, this figure revealed that, there was no relation between total scores of the nurses' level of knowledge and practice for chest tube care pre and post implementation of educational program.

**Table (1): Number and percentage distribution of the studied nurses according to their characteristics:**

Nurses' characteristics		n=50	
		No.	%
Age in years	18-<30ys	23	46.0
	30-45ys	27	54.0
	<b>Mean ± SD =</b>	<b>30.1± 7.88</b>	
Sex	Male	10	20.0
	Female	40	80.0
Educational level	Nursing Diploma	11	22.0
	Nursing Technical Institute	11	22.0
	Bachelor Degree	28	56.0
Years of experience	1-<10ys	31	62.0
	10 -<20ys	10	38.0
	<b>Mean ± SD =</b>	<b>6.94 ± 3.40</b>	
Place of work	Surgical ICU	36	72.0
	Thorathic ICU	14	28.0
Job Title	Bedside nurse	13	26.0
	Supervisor	12	24.0
	Head nurse	25	50.0
Previous attendance of training program	Yes	14	28.0
	No	36	72.0
Number of Course	One	11	22.0
	Two	2	4.0
	Three	1	2.0
Number of days	1-3 days	13	26.0
	3-5 days	1	2.0

**Table (2): Total level of nurses' knowledge about chest tube care before and after implementation of educational program:**

Total Knowledge Categories	Total number of nurses =50					
	Total Knowledge Scores				Test of Significance	
	Pre		Post			
	No.	%	No.	%	X2	P
Poor	33	66.0	0	0.0	3.209	.073
Fair	17	34.0	10	20.0		
Good	0	0.0	40	80.0		

**Table (3): The mean scores of the studied nurses' practice to chest tube care before and after implementation of educational program:**

Nurses practice Items	Total number of nurses =50			
	Mean Scores			Test of significance
	Pre	Post	t	
	Mean ± SD	Mean ± SD		P
1. Before insertion	9.94±4.45	21.16±2.40	17.79	0.000
2. During insertion	5.22±1.71	10.26±1.77	14.96	0.000
3. After insertion	6.48±2.62	12.28±1.48	16.15	0.000
4. Daily routine care	6.18 ±2.38	12.84 ± 1.70	19.58	0.000
5. Changing dressing	11.96±6.91	28.84±2.67	15.46	0.000
6. Changing drainage bottle	12.08±5.29	24.04±2.08	15.86	0.000
7. Removal of chest tube	18.22±6.19	33.14±2.22	17.76	0.000
8. Total score of practice	78.46±19.73	140.5±12.41	19.93	0.000

(\*) statistically significant at  $p \leq 0.05$

(\*\*) highly statistical significance at  $p < 0.001$

t = paired t test

**Table (4): Total nurses' practice level to chest tube care before and after implementation of educational program:**

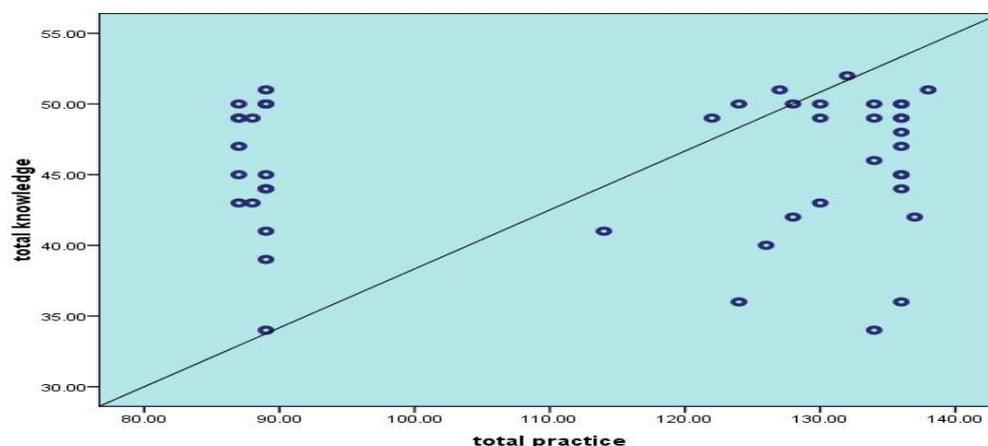
Total Practical Categories	Total number of nurses =50				Test of Significance	
	Total Practical Scores					
	Pre		Post		t	P
	No.	%	No.	%		
Competent	0	0.0	45	90.0	25.42	0.000*
Incompetent	50	100.0	5	10.0		

(\*) statistically significant at  $p \leq 0.05$

(\*\*) highly statistical significance at  $p < 0.001$

t = paired t test

**Figure (1): Correlation between total scores of the nurses' level of knowledge and practice for chest tube care**



## **5. Discussion:**

The results of the present study revealed that, more than half of the studied nurses belonged to the age group between 30 to 45 years, and the majority of the them were females (Table1), This result was in agree with Jassim, Ahmed & Al-Ganmi, (2015), who pointed in his study about " Evaluation of the nursing management for patients undergoing to water seal chest tube drainage system" and reported that most of the studied nurses were between 20 to30 and 31 to 40 years. This finding was on the same track with the finding of Anjum, (2020), who pointed in his study about "A Study to Assess the Effectiveness of Self-Instructional Module on Knowledge and Demonstration on Skill Regarding Care of Chest Tube Drainage among Staff Nurses at Skims Hospital Soura Srinagar Kashmir" and reported that, near two thirds of the studied nurses were females. This result could be due to the fact that old belief that nursing may be a private profession to females so the most of nurses in Egypt are females.

It was clarified from the current study that, educational level of the studied nurses, and nearly three quarters of them were working at surgical ICU (Table1).. This finding was disagreed with Lovely & Sangeeta, (2020), who studied "A pre-experimental study to assess the effectiveness of a structured interventional program on knowledge regarding care of patients with chest tube drainage among staff nurses in IGMC and Hospital, Shimla, Himachal Pradesh" and mentioned that, half of the studied nurses belongs to surgical ward about area of clinical experience. The researcher suggested that, the present study result might be related to the highest number of nurses working in surgical intensive care unit, as these contain two big ICU and nurses were working in critical care having workload.

In relation to the job title of the studied nurses, the current study showed that, half of the studied nurses were head nurse (Table 1). This finding was disagreement with Loughran, Cerrato, Porter & Connor, (2019), who conducted the study about "State of Nursing Practice Assessment Aggregate Result Report: Chest Tube Management in the Intensive Care Setting" and reported that, more than half of the studied nurses were staff nurse.

Concerning the total level of nurses' knowledge about chest tube care, about two-thirds of the studied nurses had poor level of knowledge before implementation of an educational program,

but after program more than two thirds of them had a good level of knowledge between nurse's level of knowledge before after implementation of an educational program with a statistically significant difference (Table 2). This result in the same line with Sandhu, Devagourou, Kumar & Manju et al., (2019), in their study about " Implementation of intercostal drainage care protocol for post-operative cardiac patients in post-operative cardiothoracic" and found that, 40% of the studied nurses had poor knowledge about chest drainage care pretest, which increased to excellent knowledge post-test on care of patient with chest drainage. Also, this finding is accepted by Ibrahim & Elshemy, (2016), in their study about " Impact of an Educational Program on Knowledge and Practices of Nurses about Caring of Patient A with Chest Tube " and reported that posttest knowledge scores of the studied nurses regarding a chest tube had significantly higher than their pretest knowledge scores. This finding might be due to more than half of the studied nurses were bachelor's degree, this finding similar with Dent, (2016), who pointed in his study about "Simulation as Staff Development for Competency in Nursing Care of Patients with Chest Tubes" and reported that almost of half of the studied nurses had bachelor's degrees.

Concerning to nurses practice to chest tube care before and after implementation of an educational program, the current study illustrated that, the total score of practice of the studied nurses about chest tube care after implementation of an educational program was improved than before with highly statistically significant difference (Table3). This finding was consistent with Awad A'elamgied Salime, Wahdan Abd El-Aziz, A Al-Metyazidy & M Weheida, (2021), who conducted a study about "Effectiveness of implementation of evidence-based educational intervention regarding chest tube on clinical patient's outcomes in cardiothoracic care unit" who showed that there were highly statistically significant differences in favor among the studied nurses concerning the total score of practice increased post EBP educational intervention than pre regarding chest tube. There searcher added that, these findings might be explained in the light of the fact that, lack of opportunity to keep nurses attend pre training program about chest tube care, lack supplies, lack time, increase number of the infant, and staff workload which affected on nurses' practice.

As regards level of nurses practice to chest tube care before and after implementation of an educational program, the current study illustrated

that all of the studied nurses had incompetent practices before implementation of an educational program, which markedly decreased after implementation of an educational program (Table 4) This finding was in the same track with the finding of Elsayed, Hassanin & Mohammed, (2016), who conducted a study about " Effect of Implementing Nursing Management Guidelines for Patients with Chest Tube Drainage on Nurses' Performance at Mansoura University Hospitals" and reported that two thirds of the studied nurses had moderate score level of practice before implementing the guidelines, then to majority of them after implementing the guidelines had high score level of practice. The researcher relays this to, lack of proper education, training, insufficient resources, and inappropriate supervision might be affected negative on their practice.

Concerning correlation between total nurses score of knowledge and practice (Figure1). The finding revealed that, there was no relation between total knowledge scores and total practice scores of nurses for a chest tube care before and after implementation of an educational program with negative statistical significance. This result was proportionate with Mohammed, Mahmoud, Sleem & Ibrahim, (2016), who conducted a study about "Assessment the Nurses Performance in Providing Care to Patients Undergoing Chest Tube in Suez Canal University Hospital" and revealed that, there was no statistically significant relationship between nurses, knowledge, and practice. The researcher viewed that, due to nearly three-quarters of the studied nurses not attending the previous training program (Table 1). This finding was in an agreement with Hamel & Ahmed, (2020), that conducted a study about "Effectiveness of an Educational Program on Nurses' Knowledge and Practices Regarding Nursing Interventions of Chest Tube Drainage System in Ibn Alnafees Teaching Hospital" and reported that majority of the studied nurses had no past training.

## **6. Conclusion:**

There was an improvement in the nurses' knowledge and practice after implementation of the educational program than before regarding care of infants with chest tube.

## **7. Recommendations:**

In the light of the findings of the current study, the following recommendations are suggested:

- Provide in-services, up to date, regular training programs to improve nurses' knowledge and practice regarding care of the infant with chest tube.
- Importance of presence of protocol related to care of the infant with chest tube.

## **8. References**

- 1.Abdellatif, M. A., & Abdellatif, D. A. (2012).** Pneumothorax in the neonatal intensive care unit in Cairo University Hospital. *Journal of the Egyptian Society of Parasitology*; 42(2): 495-506.
- 2.Abdel Salam, R., & EL Shemy, M. (2016).** Impact of an Educational Program on Knowledge and Practices of Nurses about Caring of Patient with Chest Tube. *Journal of Nursing and Health Science*; 5(6): 24-32.
- 3.Afsharpaiman, S., Izadi, M., Ajudani, R., & Khosravi, M. H. (2016).** Pleural effusion in children: A review article and literature review. *International Journal of Medical Reviews*; 3(1): 365-370.
- 4.Anjum, N., (2020).** A Study to Assess the Effectiveness of Self-Instructional Module on Knowledge and Demonstration on Skill Regarding Care of Chest Tube Drainage among Staff Nurses at Skims Hospital Soura Srinagar Kashmir. *Journal of Nursing and Health Science* (PP 16-43).
- 5.Awad A'elamgied Salime, R., Wahdan Abd El-Aziz, W., A Al-Metyazidy, H., & M Weheida, S. (2021).** Effectiveness of implementation of evidence-based educational intervention regarding chest tube on clinical patient's outcomes in cardiothoracic care unit. *Egyptian Journal of Health Care*; 12(1): 171-192.
- 6.Dent, J. (2016).** Simulation as Staff Development for Competency in Nursing Care of Patients with Chest Tubes.
- 7.Densie, F., & Tanto, C. (2014).** *Essentials of Nursing Research*. (4<sup>th</sup> ed.) Wolf and WolterCompany, USA.157-159.
- 8.Diaz, R., Patel, K. B., Almeida, P., Shekar, S. P., Hernandez, F., & Mehta, J. P. (2020).** Are chest radiographs routinely indicated after chest tubes placed for non-surgical reasons are removed?. *Cureus*, 12(3).
- 9.Dobra, J., et a l. (2001).** AACN procedure manual for critical care, 4<sup>th</sup>ed., W.B.

- Saunders Company; pp 101-106:111-114;118-120:124-125.
10. **Elsayed, N., Hassanin, A., & Mohammed, H. (2016).** EFFECT OF IMPLEMENTING NURSING MANAGEMENT GUIDELINES FOR PATIENTS WITH CHEST TUBE DRAINAGE ON NURSES' PERFORMANCE AT MANSOURA UNIVERSITY HOSPITALS. *Mansoura Nursing Journal*; 3(1): 315-333.
  11. **Jacob, A. (2007).** *Clinical Nursing Procedures: The Art of Nursing Practice* Jacob. JAYPEE BROTHERS PUBLISHERS; pp.406: 410.
  12. **Jassim, S., Ahmed, S. A., & Al-Ganmi, A. H. A. (2015).** Evaluation of the nursing management for patients undergoing to water seal chest tube drainage system. *Kufa Journal for Nursing sciences*; 5(2).
  13. **Hamad, A. M. M., & Alfeke, S. E. (2021).** Small bore catheter is more than an alternative to the ordinary chest tube for pleural drainage. *Lung India*; 38(1), 31.
  14. **Hamel, O. L., & Ahmed, S. A. (2020).** Effectiveness of an Educational Program on Nurses' Knowledge and Practices Regarding Nursing Interventions of Chest Tube Drainage System in Ibn Alnafees Teaching Hospital. *Indian Journal of Public Health Research & Development*; 11(4).
  15. **Ibrahim, R., & Elshemy, M. (2016).** Impact of an Educational Program on Knowledge and Practices of Nurses about Caring of Patient with Chest Tube. *IOSR Journal of Nursing and Health Science*; 5(6): 2320-1940.
  16. **Lovely & Sangeeta, S. (2020).** A pre-experimental study to assess the effectiveness of a structured interventional program on knowledge regarding care of patients with chest tube drainage among staff nurses in IGMC and Hospital, Shimla, Himachal Pradesh. *International Journal of Advance Research, Ideas and Innovations in Technology*.
  17. **Loughran, P., Cerrato, B., Porter, C., & Connor, J., (2019).** Chest Tube Management in the Intensive Care Setting Boston Children's Hospital Consortium for Congenital Cardiac.
  18. **Mohammed, M. A., Mahmoud, M. E., Sleem, H. A., & Ibrahim, N. M. (2016).** Assessment the Nurses Performance in Providing Care to Patients Undergoing Chest Tube in Suez Canal University Hospital. *International journal of Nursing Didactics*; 6(9): 19-26.
  19. **Panza, R., Prontera, G., Ives, K. N., Zivanovic, S., Roehr, C. C., Quercia, M., ... & Laforgia, N. (2020).** Pigtail catheters versus traditional chest drains for pneumothorax treatment in two NICUs. *European journal of pediatrics*; 179(1): 73-79.
  20. **Patidar, D., Patidar, K., & Patel, A. (2021).** A Study to assess the effectiveness of Self Instructional module on Knowledge about practice regarding management of patient with chest tube drainage among Nurses working in selected hospitals of North Gujarat. *International Journal of Nursing Education and Research*; 9 (1) , 67-68.
  21. **Salime, R. A. A. E., Abd EL-Aziz, W. W., Al Metyazidy, H. A., & Weheida, S. M. (2021).** Effectiveness of implementation of evidence based educational intervention regarding chest tube on clinical patient's outcomes in cardiothoracic care unit.
  22. **Sandhu, H. S., Devagourou, V., Kumar, P. S., Manju, D., & Gopichandran, L. (2019).** Implementation of intercostal drainage care protocol for post-operative cardiac patients in post-operative cardiothoracic ICU. *Baba Farid University Nursing Journal*; 16(1): 20-26.
  23. **Shaker, M. (2011).** Nurses' Performance Regarding Management of Patients with Chest tube, Ain Shams University.
  24. **Tan, Y. L., Zhan, Y., Geng, J., Chen, W., & Guo, W. L. (2020).** Predictors of chest drainage of pneumothorax in neonates. *Brazilian Journal of Medical and Biological Research*; 53(8).
  25. **Weissler, J. M., Cho, E. H., Koltz, P. F., Carney, M. J., Itkin, M., Laje, P., ... & Kovach, S. J. (2018).** Lymphovenous anastomosis for the treatment of chylothorax in infants: a novel microsurgical approach to a devastating problem. *Plastic and reconstructive surgery*; 141(6), 1502:1507.