

## Effectiveness Of Early Warning Sign's Detection Educational Sessions For Nurses On Clinical Outcomes Of Post Open Cardiac Surgery Children

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### Abstract

**Background:** The Pediatric Early Warning System (PEWS) has been validated for using in pediatric acute care settings for early identification of children at increased risk of physiological deterioration. Also, it can be used in caring children's post open cardiac surgery for early detection, prompt management of deteriorating domains and consequently improve their clinical outcomes. **Aim:** this study aimed to study the effectiveness of early warning sign's detection educational sessions for nurses on clinical outcomes of post open cardiac surgery children. **Method:** A quasi-experimental design was conducted on a sample of 50 nurses worked at pediatric cardiac intensive care unit (PCICU) & cardiac department of Mansoura University Children's Hospital (MUCH), with a purposive sample of 50 children who admitted to the previously mentioned setting and fulfilling the criteria of selection. **Tools:** A structured interview questionnaire sheet for nurses' knowledge, observational checklist for nurses' practices to pediatric early warning signs (PEWS), nurses' abilities observational checklist and children's clinical outcomes tool. **Results:** the majority of the studied nurses' had good knowledge and most of them had competent practices about pediatric early warning signs detection post implementation of educational session with a highly statistical significant difference. Also, the majority of children's were suffer from different risks/complication such as shock, breathing difficulties pre implementation of educational session which eliminated post implementation of educational session. **Conclusion:** There was an improvement in nurses' knowledge and practices after implementation of the educational sessions as well as on the pediatric children's post open cardiac surgery as represented by a decrease in percentages of associated complication. **Recommendations:** Provide in-services, up to date and regular training programs to improve nurses' knowledge and practices regarding the use of PEWS for their children post open cardiac surgery. Further studies are recommended to repeat this study on a larger sample size and on a wide scale in various governorates of Egypt.

**Keywords:** Children's, Educational sessions, Knowledge, Nurses, Open heart surgery, Outcomes, Pediatric early warning signs and Practices.

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### I. Introduction

Despite advances in medical technology in-hospital, Pediatric congenital disorder are reported in 5.5% to 14% of pediatric ICU admission and 0.7% to 20% of overall pediatric admission (McLellan and Connor, 2016) resulting in mortality rates up to 7% of neonatal deaths who, are attributable to congenital malformation, 25% of these congenital defects are cardiovascular globally while, 2 to 12 % of deaths are reported in Nigeria, South Africa, and Egypt (Hussein, Jaime, and Abbas, 2017) All types of CHD which require open-heart surgical intervention during infancy, open heart surgery a recognizable medical procedure improves the significance of heart and save lives. Open-heart procedures themselves vary in complexity, duration, and risk, but all have a strong potential to be traumatizing to the child and family for children's with CHD. The occurrences of complications post open heart surgery the greatest public reasons of operative morbidity and including placement in pediatric cardiac intensive care unit for days or weeks to manage this complication such as blood clots, emboli, arrhythmia, heart attack, and stroke, pneumonia, bleeding, coagulopathy, over 10% of children's experiencing infection and cyanosis (Gaytan, O'Connell, Mack and Leon, 2015).

Open-heart surgery places children at risk for numerous significant health problems and complications such as cardiac arrest that resulting from late recognition and identifications of these risks therefore, those children with this surgical procedure require an earlier intervention to improves their out-comes. Systematic nursing assessment is vital during the post-operative period to identify rapidly any complications and

deterioration in children condition and include monitoring cardiovascular status, ventilator parameters, fluid balance and neurological status. Health care providers often miss observable warning signs exhibited by children's prior to deterioration occurred so that we needed to scoring systems that help to identify children's at risk for decompensation and early recognition, early intervention that can reduce cardio-pulmonary arrest and reduce length of stay in hospital (**Tucker, Brewer, Baker, and Demerit, 2019**).

Open-heart surgery is needed for the child's wellbeing and repair of many cardiac defects which is usually require an additional concentration to the children in the pre - operative period that, can guide to a quicker post - operative improvement (**Miller, Elverson and Correa, 2017**). Additionally, there is a multifaceted approach for improving pediatric inpatient safety and clinical outcomes in today's healthcare systems which is identified as Pediatric Early Warning Score (PEWS). The Pediatric Early Warning Score (PEWS) is the first reported scoring system designed to identify pediatric patients at risk for decompensation or deteriorations (**Monaghan, 2005**).

Pediatric Early Warning Score (PEWS). It is a standardized tool to evaluate different physiological, behavioral, clinical condition of the child to identify serious physiological disturbances at risk of deterioration and assigning a score there the to assessment. This scoring tool it composed of three domains included: behavior assessment, cardiovascular and respiratory assessment, that used to calculate the PEWS score that ranging from 0 to 3 possible points and hence, determine children at risk. Total PEWS scores ranged from 0-9 with higher scores indicating greater risk of clinical deterioration (**Akre and Frankenstein, 2015**).

Pediatric early warning system (PEWS) was developed to standardize language, assessment criteria, and the process for identifying early clinical deterioration in pediatric patients as well as guiding nursing actions for additional assessments and prompt immediate treatment. The nurse assigns a PEWS score for the pediatric patient by using a table to assess specific criteria within three physiologic systems (child behavior (neurologic); cardiovascular; and respiratory) (**Bona fide, Roberts and Tibbetts, 2018**) PEWS is helpful to detecting their children at-risk, reduce child morbidity and mortality, timely transfer of deteriorating children, improving their clinical outcomes and facilitate interventions that save lives. It also provides nurses with step-by-step supported PEWS score to alert staff to degeneration in clinical status of children, promotes staff communication, support for clinical decision making and removing bias in assessment, promotes honesty of health care, delivery to support independence and proper allocation of resources (**Duncan and Hutchison 2016**).

#### ***Aim of the study***

The study aims is to evaluate the effectiveness of early warning sign's detection educational sessions for nurses on clinical outcomes of post open cardiac surgery children.

#### ***Research hypothesis:***

- Nurses will have higher level of knowledge and practice related to detection of early warning signs in children on post- test than pretest
- There will be a significant reduction in the incidence of deterioration, complication, length of hospital stay and improve children's clinical outcomes after the implementation of pediatric early warning signs (PEWS).

#### ***Subjects and Method***

##### ***Design:***

A quasi-experimental design was used to accomplish this study. It is an empirical study used to estimate the effect of an intervention on its target population without random assignment. One-group pre-posttest is one of the most frequently used quasi-experimental research designs in which a single group of research participants or subjects is pretested, given some treatment or independent variable manipulation, and then post tested (**Spurlock, 2018**).

##### ***Setting:***

This study was conducted at Pediatric Cardiac Intensive Care Unit (PCICU) & cardiac department affiliated to Mansoura University Children Hospital (MUCH), which provides health services to children cases from Mansoura & surrounding areas at Dakahlia governorate

##### ***Subjects:***

A sample of 50 nurses worked at PCICU and cardiac department of Mansoura University Children Hospital (MUCH) with a purposive sample of 50 children who admitted to the previously mentioned setting throughout three months and fulfilling the criteria of selection such as; age from birth to 18 years, both gender, free from other congenital defect and post open cardiac surgery.

**Tools:**

**Tool I: A structured interview questionnaire sheet (pre/post format):**

It was developed by the researcher after reviewing the related literatures to obtain data about:

**Part 1: Demographic characteristics of the studied nurses:** It composed of (6) questions asking about age, sex, level of education, years of experience and previous training about Pediatric Early Warning Signs (PEWS).

**Part 2: Nurses' knowledge about Pediatric Early Warning Signs (PEWS) (pre /post format):** which composed of (19) questions covered the following item: definition, objectives, advantages, components, methods of assessment peripheral and central blood vessels, signs of delayed, frequency of applying PEWS, signs of child deterioration, complication /risks post open cardiac surgery, normal vital signs of different age groups from birth –18 years.

**Scoring system:**

For each question a score(1)was given for correct answers and(0) for incorrect, missed or unknown answers. The total knowledge score for (19) question was (34) marks.

**The level of nurses' knowledge was categorized in to the following:**

Good knowledge score: > 75% (>25.5 marks).

Fair knowledge score: 50-75% (17-25.5 marks).

Poor knowledge score:<50% (<17 marks)(El-Razky, 2017).

**Tool II: Nurses' practices to Pediatric Early Warning Signs (PEWS) (pre /post format):**

**(a) Observational checklist:** Adopted from (Monaghan, 2005), to assess nurses' performance during applying Pediatric Early Warning Signs (PEWS) on children to detect children's deterioration through recording early warning signs such as child behavior, cardiovascular assessment and respiratory assessment. It composed of 3 domains, each domain score ranges from 0-3 and the total score ranges from 0 – 9.

**Scoring system:**

A score (2) was given to done completely, (1) was given to done incompletely and (0) was given to not done.

**The level of nurses' performance to Pediatric Early Warning Signs (PEWS) domain was categorized in to the following:**

Competent practice score: ≥75% (≥4.5marks).

Incompetent practice score: <75% (<4.5marks).(Noah, 2017).

**(b) Nurses' reported practices regarding child's outcome /total assessment using Pediatric Early Warning Signs (PEWS) scale:** It composed of(4) questions to assess nurses interpretation to the children total assessment score using PEWS scale.

**Scoring system:**

A score (2) was given to done completely, (1) was given to done incompletely and (0) was given to not done.

The total nurse's reported practice score for (4) question was ( 8 ) marks.

**The level of nurses' reported practices were categorized in to the following :**

Competent practice score: ≥75% (≥6marks).

Incompetent practice score: <75% (<6 marks). (Noah, 2017).

**Tool (III): Nurses' abilities observational checklist (pre / post format):**

It was developed by the researcher to assess nurses abilities to monitor the children's clinical conditions. It consist of 7 items about early detection, early intervention, decision making if the child will transfer out of PCICU or need more intervention & care, able to identify children's condition progress quickly, apply cardiovascular, respiratory assessment to child and record children's physiological observation .

**Scoring system:**

For each question; a score (2) was given to done completely, (1)was given to done incompletely and (0) was given to not done. The total nurses' abilities score for (7) question was(14) marks.

**The total score of nurses' abilities were categorized in to the following:**

Competent practice score: ≥75% (≥10.5marks).

Incompetent practice score:<75(<10.5 marks).

**Tool (IV): Children's Clinical Outcomes: (pre / post format)**

It was developed by the researcher based on review of related literature to assess child outcomes post open cardiac surgery and include data about:

- Children's demographic and clinical data such as age, gender, diagnosis, admission date, length of hospital stay, length stay in PCICU.
- Children's clinical status assessment such as vital signs, oxygen saturation, capillary refill time, intake, output, consciousness level.
- Complications / Risks post open cardiac surgery and children's condition on discharge.

#### **Operational design:**

**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. The content validity of the study tools was assessed and revised by five nursing experts in the field of the study. The internal consistency of the study tools was tested by using Cronbach's alpha coefficient  $r = 0.48$  and  $0.7$  for tool I (part 1 & 2 respectively),  $r = 0.66$  for tool II and  $r = 0.73$  for tool III

**2- Exploratory phase:** It includes pilot study and filed work.

#### **A pilot study:**

It was carried out on 10% of the total sample (5 nurses and 5 children) who were selected randomly and fulfill the criteria of selection 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. No necessary modification were done. Therefore, the pilot study were included in the total sample.

#### **Filed work:**

- **Data collection period:**

Data collection extended over a period of three months from first of April to the end of June 2019. The researcher started by introducing herself to the nurses and giving them a quick idea about the aim and nature of the study. The researcher attended two days per week in the study setting from 9.00 am to 3.00 pm.

- **Study framework:** was carried out to 5 phases as the following:

**Phase 1: Initial data collection (Assessment phase):** Assessment of the existing nurses' knowledge and practices regarding use PEWS detection (**tool I & II**).

- Each nurse was interviewed individually before applying the early warning signs educational sessions in order to collect nurses' data base line using the study **tool (I) part (1)**.

- Assessment of nurses' knowledge about PEWS was performed using **tool (I) part (2)**.

- Assessment of nurses practices about applying PEWS on children was performed using **tool (II) (a & b)**.

- Assessment of children outcomes post open cardiac surgery at PCICU by using children's clinical outcomes tool pre and post implementation of educational session.

- **Phase 2: Setting goals and objectives:** Based on the findings of the assessment phase goals, priorities, and expected outcomes will be formulated to improve both nurses and children's outcomes.

- **Phase 3: Development of educational sessions for nurses about PEWS detection among post open cardiac surgery children:** Taking into account the existing evidence-based literature, required knowledge, practices, determine suitable time of each part and identify teaching strategy. In this phase, the researcher was planned two sessions regarding PEWS.

- **First session:** at the beginning of this session, the researcher introduced herself and explained the objectives of these sessions. It covered; definition, objectives, advantages for children and nurses, component of PEWS, PEWS Score, nursing interventions associated with different PEWS scores, assessment pediatric vital signs. It took 45- 60 minutes for discussing its items taking into consideration the attention span of nurses.

- **Second session:** this session included training of the studied nurses on the applying early warning scoring system tool for post- open cardiac surgery children and its effect on their outcomes. It took 45- 60 minutes for discussing its items taking into account the attention span of nurses.

**Phase 4: Implementation of educational sessions for nurses:**

- Educational sessions was included 50 nurses, each nurse was included two session /week, each session It took 45- 60 minutes.

- Each educational sessions took between 45 – 60 minutes to debate its items, taking into account span of nurses

- Each practical sessions took between 45 – 60 minutes to debate its items, taking into consideration span of nurses

- The researcher observes nurses' practices pre and post implementation of the educational session in the morning and afternoon shifts using a tool (II)

- Each session started at 9 am for morning and at 3 pm for afternoon shifts
- The studied nurses were divided into 5 groups; each one consisted of 10 nurses. During the session, researcher used questions, discussion and different teaching methods as group discussion, question and electronic brain storming such as (video conference), demonstration and re-demonstration. Numerous didactic aids were used, such as handout guideline and power point.
- Assessment of children's outcome post cardiac surgery at pediatric cardiac intensive care unit was performed by using children's clinical outcomes tool pre and post implementation of the educational session on 50 PCICU children.
- Guiding colored booklet about PEWS was given to every nurse after the assessment phase (during the first session) for attracting her attention, motivated her and help her for reviewing its content when needed.
- Brief, clear and straightforward words used during the session by the researcher. Similarly as at the end of every session, a quick summary was given.

#### **Phase 5: Evaluation of educational Session's effectiveness:**

- Each nurse was interviewed to collect data after applying pediatric early warning system score as a post test in order to evaluate her knowledge and practice by using the same pre -test format. Also children clinical outcomes was assessed after implementing nurses educational session about PEWS using the same pre -test format.
- Comparison between nurses' pre and post -test finding were done to work out the impact of the educational session on nurses' knowledge and practice during caring post open cardiac surgery children's , while comparison between child' pre and post-test finding were done to work out the impact of the educational session on nurses' performance level for improving children clinical outcomes.

#### **Ethical Considerations**

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.

#### **Statistical design**

The collected data were coded and entered to the statistical package of social sciences (SPSS) version 20. After complete entry, data were explored for detecting any error, then it was analyzed by the same 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 pediatric early warning signs 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 ( $P < 0.001$ ).

## **II. Results**

Concerning characteristics of the studied nurses. **Table (1)** showed that, 44% of the studied nurses were in the age group from 20 to less than 30 years of age with the mean age of  $30.1 \pm 7.88$  years. 50% of them were bachelor degree of nursing. As regards to years of experience, 38% of the studied nurses were had 1 to less than 5 years of experience. In addition, More than two of the studied nurses (78%) did not receive any training program about pediatric early warning signs (PEWS) detection for children.

**Table (2)**, It was found that, 30% of the studied children's were in the age group from 3-<6 years of age, and it was observed the mean score of children age in months was  $23.48 \pm 21.6$ . In relation to gender, 58% of them were boys.

In relation to the total nurse's knowledge about pediatric early warning PEWS scale. **Figure (1)** clarified that, 90% of the studied nurses had poor knowledge pre implementation of the educational session. which increased to higher percentage 94% of them had good knowledge post implementation of the educational session.

As regards nurse's total performance about PEWS scale for post open cardiac surgery children. **Table (3)** interpreted that, there was a highly statistical significant differences between pre and post implementation of educational sessions at  $p < 0.001$ . It was noticed that, 98% of the studied nurses had incompetent practice pre of

the educational session implementation, which markedly increased to higher percentages of them had more competent practice post implementation of educational session. It was noticed from this table that, the mean scores of total nurses' performance to PEWS pre implementation of the educational session was  $1.3 \pm 1.12$  that increased post implementation of the educational session to  $5.94 \pm 0.42$ .

Regarding percentage destitution of children's complication/risks post open cardiac surgery. **Table (4)** It clarified that, there were a highly statistical significant differences between pre and post implementation of educational session ( $p < 0.001$ ) in relation to children complication / risks post open cardiac surgery, in which the majority 92% of children's were suffer from different risks/complication such as shock, breathing difficulties pre implementation of educational session which eliminated post implementation of educational session. Furthermore, 74% of them high feverish pre implementation of educational session. which decreased to 12 % of them have normal temperature post implementation of educational session. In addition 56% of them high cyanosed pre implementation of educational session. which decreased to 26% post implementation of educational session respectively with a highly statistical significant differences at  $p < 0.003$ .

Regarding percentage destitution of the studied children' condition on discharge post open cardiac surgery. **Figure(2)** It portrayed that, 60% of the studied children had live in hospital pre implementation of educational session, which increased to 72% of them post implementation of educational session. In addition the same table showed that, less than one third 22% of them discharged home post open cardiac surgery pre implementation of educational session, which slightly increased to 24% of them post implementation of educational session.

**Table (1): Number and Percentage Distribution of the Studied Nurses according to their Characteristics**

Nurses' characteristics		No=50	
		No.	%
Age in years	<20ys	5	10.0
	20-<30ys	22	44.0
	30-<40ys	17	34.0
	$\geq 40$ ys	6	12.0
	<b>Mean <math>\pm</math> SD =</b>	<b>30.1<math>\pm</math> 7.88</b>	
Sex	Male	7	14.0
	Female	43	86.0
Educational level	Nursing Diploma	16	32.0
	Nursing Technical Institute	9	18.0
	Bachelor Degree	25	50.0
Years of experience	<1ys	7	14.0
	1-<5ys	19	38.0
	5-<10ys	8	16.0
	$\geq 10$ ys	16	32.0
	<b>Mean <math>\pm</math> SD =</b>	<b>5.94 <math>\pm</math> 3.40</b>	
Did you applying early warning sign's detection for children	Always	3	6.0
	Sometimes	24	48.0
	Never	23	46.0
Previous attendance of training program	Yes	11	22.0
	No	39	78.0

**Table (2): Number and Percentage Distribution of the Studied Children according to their Characteristics**

Child characteristics		No= 50	
		No.	%
Child age	<1month	1	2.0
	1month-<1 years	9	18.0
	1-<3 years	13	26.0
	3-<6 years	15	30.0
	6-<12years	10	20.0
	12- $\leq 18$ years	2	4.0
	<b>Mean<math>\pm</math> SD in months</b>	<b>23.48<math>\pm</math>21.6</b>	
Gender	Male	29	58
	Female	21	42

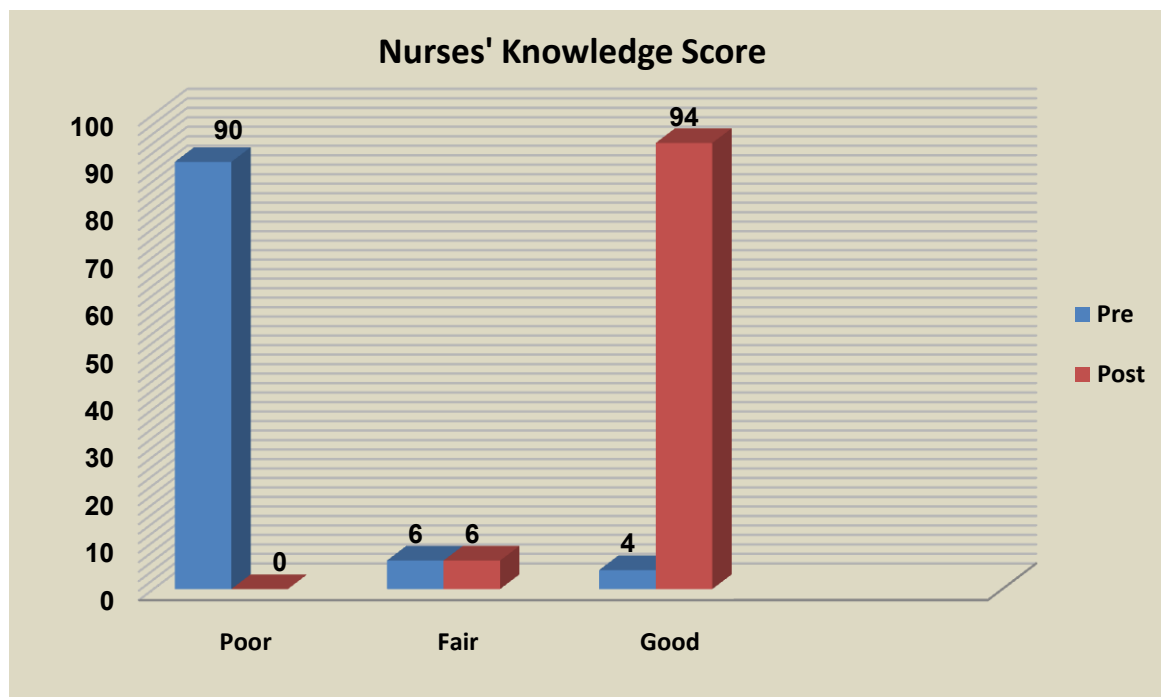


Figure (1): Percentage Distribution of Total Nurses' Knowledge Score about Pediatric Early Warning Sign's (PEWS)

Table (3): Percentage Distribution of Total Nurses' Performance Score to Pediatric Early Warning Sign's (PEWS)

Total Practical Categories	Total number of nurses =50					
	Total Practical Scores				Test of Significance	
	Pre		Post		t	P
No.	%	No.	%			
Competent	1	2	49	98	26.42	0.000*
Incompetent	49	98	1	2		
Mean ± SD	1.3±1.12		5.94 ± 0.42			

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

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

t = paired t test

Table (4): Percentage Distribution of Children's Complication/ Risks Post Cardiac Surgery

Items	No= 50					
	Pre-session implementation No=50		Post-session implementation No=50		Test of significance	
	No.	%	No.	%	t	P
1. Bleeding after surgery	32	64	0	0	9.33	0.000*
2. Blood clots (thrombosis)	15	30.0	0	0	4.58	0.000*
3. Stroke	27	54.0	0	0	7.58	0.000*
4. Pneumonia	15	30.0	2	4.0	3.48	0.001*
5. Shock	49	98.0	3	6.0	23.73	0.000*
6. Arrhythmia	9	18.0	5	10	1.27	0.209
7. Cardiac arrest	32	64.0	0	0	9.33	0.000*
8. Cyanosis	28	56	13	26.0	3.13	0.003*
9. Fainting	25	50	5	10.0	5.29	0.000*
10. Pulmonary hypertension	16	32.0	0	0	4.80	0.000*

11.	Infection of the chest wound	12	24.0	0	0	3.93	0.000*
12.	kidney failure	19	38.0	0	0	5.48	0.000*
13.	Lung failure	0	0	0	0	0	0.000*
14.	Breathing difficulties	46	92.0	13	26.0	9.75	0.000*
15.	Chest pain	22	44.0	19	38	0.62	0.53
16.	Fever	37	74.0	6	12.0	7.72	0.000*

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

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

t = paired t test

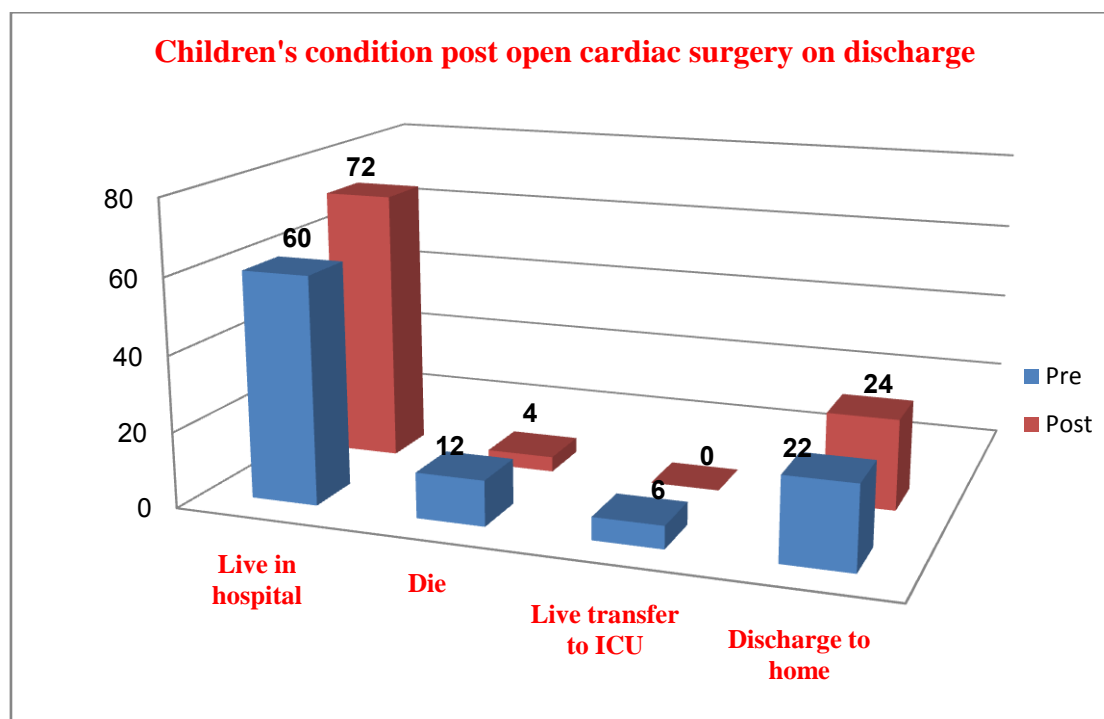


Figure (2): Percentage Distribution of Children's Condition Post Open Cardiac Surgery on Discharge.

### III. Discussion

The results of the present study revealed that over a third of the studied nurses belonged to the age group between 20 and less than 30 years (Table 1). This finding was in line with Koi sick, (2019) who conducted a study on " Using a Pediatric Early Warning Score Algorithm for Activating a Rapid Response Team, Walden university at the United States " and found that 36 % of the nurses were between 20 and 30 years old. From the researcher's point of view, this result could be due to the fact that nurses of this age had not recently graduated and were in the middle age of their career.

Concerning the total nurses' knowledge about PEWS (Figure 1). The study showed that, the vast majority of the studied nurses had poor knowledge about (PEWS) scale for children pre implementation of the educational session, which increased to become a very higher percentage of nurses who had a good knowledge post implementation of the educational session. This finding disagreed with Douglas, Collude and Keller, (2016) who studied " Implementation of a pediatric early warning scoring system at an academic medical center among upper elementary African-American children " and proved that, more than one third of the nursing staff of ICU had a good level of knowledge about pediatric early warning signs detection (PEWS) scale for children before an educational program which improved after the educational program. From the researcher point of view, this finding could be attributed to the half of the studied nurses had a diploma and technical institute certificate and lack of opportunity to keep nurses aware about updates about PEWS program, which might preclude the nurses from remembering, understanding and applying suitable knowledge regarding PEWS and had no more time to attend any training program.

As regards total nurse' performance score to pediatric early warning sign's (PEWS), the finding illustrated that, the vast majority of the studied nurses' had incompetent practices pre implementation of the



educational session, which markedly increased to higher percentages of them had more competent practice post implementation of educational session (**Table 3**). This finding was in the same line with **Mandell, Bynum and Marshall, (2015)** who studied "Pediatric Early Warning Score and unplanned readmission to the pediatric intensive care unit Boston Children's Hospital in Orland" and reported that, the majority of them had poor practice score before program implementation. While, this result was contradicted with **Lambert and Matthews, (2017)** who conducted in a study about "Detecting Pediatric Patient Deterioration using PEWS of Dublin City University in Ireland " and revealed that, the majority of nurses had a satisfactory practice before program implementation. the researcher believed that, This result might be due to the lack of opportunity to keep nurses attend pre training programs regarding PEWS and it's implementations.

It was clarified that, there were a highly statistical significant differences between pre and post implementation of educational session ( $p < 0.001$ ) in relation to children complication/risks post open cardiac surgery, in which the majority of children's were suffer from different risks/complication such as shock, breathing difficulties pre implementation of educational session which eliminated post implementation of educational session (**Table 4**). This result was contradicted with **Stephanie, Brown, Garcia and Agulnik, (2019)** who conducted a study about "Scoping Review of Pediatric Early Warning Systems (PEWS) in Resource-Limited and Humanitarian Settings, University of Washington, Seattle, United States " and reported that, the minority of children had many complications post open cardiac surgery before implementation of training program. The researcher suggested that, the present study result might be related to lack of early detection and monitoring early warning signs of children post open cardiac surgery and lack of nurses training about PEWS scale for children affect negatively on their outcomes.

On top of that, it was obvious, less than one third of the studied children discharged home pre implementation of the educational session (**Figure 2**). This result was in an agreement with **Pansare, Harris, Mills, Messina and Parker, (2014)** who conducted a study about "Characteristics and outcomes of pediatric rapid response teams before and after mandatory triggering by an elevated Pediatric Early Warning System (PEWS) score in America" and reported that, the minority of the pediatric patient discharged at home while 96% requiring medical intervention. and stayed on the hospital before demonstration of PEWS intervention. The researcher relays this to, the majority of these children are suffering from different risk / complication post open cardiac surgery this affect negatively on their outcomes as reflected from Table (4) and lack of nurses experience to provide them prompt intervention before children deteriorated.

#### **IV. Conclusion**

There was an improvements in the nurses' knowledge and practice of PEWS after implementation of the educational sessions than before its implementation. Additionally, the intervention of educational session of PEWS had a positive effect on the pediatric children's post open cardiac surgery as represented by a decrease in percentages of them associated complications such as pneumonia, breathing difficulties , hypoxia and blood clots, strokes, who had the vast majority of them 98% had more complications pre implementation of educational session, which decreased to one quarter or less post implementation of educational session as well as a decrease in their length of hospital stay post session implementation.

#### **Recommendations:**

- Providing up-to-dated, regular educational programs about PEWS should be developed for nurses in PCICU. This should provide them with up-dated knowledge, which can be translated in to practice. Programs should be directed at all levels of health care providers including child, family or caregivers.
- Information relate to PEWS can be provided in formats and ways as manual booklets and pamphlets that are suited to nurses' level of understanding.
- Applying PEWS tool into nursing care protocols and records as a routine.
- Ongoing evaluation of PEWS practice is recommended to ensure that educational sessions' content remains evidence-based.

#### **Further Studies are needed:**

- Study Assessment of the risk factors and barriers that affect on nurses' application to PEWS for pediatric patients
- Study prevalence of cardiac arrest post open heart surgery in children hospitals in Egypt and association with PEWS indicator
- Replication of this study with a larger sample at different pediatric intensive care units and with longitudinal follow-up so that the results could be generalized and compared for differences between Egypt and other countries.
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