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## The Effect of Implementing A designed SKIN Care Bundle Protocol on Modifying Nurses' Practices toward Pediatric Intensive Care Unit Patients

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**Abstract: Background:** Pressure ulcer has been described as one of the most costly and physically debilitating complications in the 20<sup>th</sup> century and they are the third most expensive disorder after cancer and cardiovascular diseases. A significant amount of evidence has accumulated indicating that SKIN care bundle is considered as an essential component of pressure ulcer prevention practice for nurses to combat the incidence of pressure ulcers. However, standardized guidelines and protocols for pressure ulcer prevention in pediatric intensive care units have not been universally implemented. **Aim:** This study aimed to evaluate the effect of implementing a designed SKIN care bundle protocol on modifying nurses' practices toward pediatric intensive care unit patient. **Subject and method:** A quasi experimental design was used. The study was conducted at the pediatric medical intensive care units affiliated to Mansoura University Children's Hospital (MUCH) and international Hospital of Sandouq in El - Mansoura City, Egypt. The study included a convenience sample of 84 nurses, 105 pediatric intensive care unit patients, recruited for six months' period. **Tools:** Three tools were used to collect data. **Tool 1:** An interview questionnaire sheet for nurse's knowledge. **Tool 2:** Observational checklist used to determine nurses' performance regarding SKIN care bundle. **Tool 3:** Braden scale risk assessment tool to assess severity of risk for developing pressure ulcer among critically ill pediatric patients. **Results:** The majority of the studied nurses didn't receive any training program about SKIN care bundle for pressure ulcer prevention and more than one third of the studied nurses had an insufficient knowledge, as well as more than half of the studied nurses had an unsatisfactory practice regarding SKIN care bundle preprogram, which improved to have a sufficient knowledge and a satisfactory practice after the program and at follow up respectively. There was a significant positive association between nurses' knowledge and practice at  $p < 0.001$ . **Conclusion:** The program had a positive effect on the critical care nurses' knowledge & practices as well as on the pediatric intensive care unit patients as represented by a decrease in percentages of the studied pediatric patients who had a high risk for PUs development to immediately after & at follow up program implementation respectively. **Recommendation:** Including SKIN care bundle interventions & Braden risk assessment into nurses' routine care and developing regular and continuous educational programs for the critical care nurses according to their needs aiming at refreshing their knowledge and improving their practice for critically ill pediatric patients

**Key words:** Nurses, Practice, SKIN care bundle, Pediatric intensive care unit patients.

### INTRODUCTION

Now a days, pressure ulcer is recognized worldwide as one of the most common and highly relevant nursing care issues in hospitals<sup>(1)</sup>. Pressure ulcers (PUs) are complex lesions of the skin and underlying tissues that develop as a result of prolonged or repeated ischemic insults without adequate time for total tissue recovery resulting in tissue necrosis<sup>(2)</sup>. The precise incidence of pressure ulcer couldn't be generalized, as its incidence is different in each clinical settings. European Pressure Ulcer Advisory Panel (EPUAP) has been reported the prevalence rates of pressure ulcer in the United States to be as high as 10.2% to 32% in pediatric intensive care units (PICUs) and 27% in neonatal intensive care units (NICUs)<sup>(3)</sup>.

The mechanism of pediatric pressure ulcer formation is similar to the mechanism in adults, but the most common sites for pressure ulcer development are different because of physiological differences in infants and children, for example, the head makes up a greater proportion of the total body weight and surface; thus, the occipital region of the scalp is the most common site of ulceration for infants and children<sup>(4)</sup>.

There are many risk factors associated with the development of pressure ulcers, which defined as intrinsic and extrinsic factors.<sup>(5)</sup> Intrinsic factors are including duration, amount of pressure, friction, shear and moisture. While, extrinsic factors are including poor perfusion, malnutrition, infection, anemia and immobility but a recent study reported that, low albumin levels are an indicator of malnutrition<sup>(6)</sup>. Otherwise, many studies pointed that, prolonged pressure is the main and primary leading contributing factor in which there is an inverse relationship between the degree of pressure and the duration of pressure. Uninterrupted higher pressure requires shorter time while continuous lower pressure will require longer time to cause tissue necrosis and pressure ulceration<sup>(7)</sup>.

Pressure ulcers were classified as stage one through stage four, in which stage one representing the earliest stages of PUs formation that are characterized by intact skin, while stage four representing the severest grade of pressure ulcer that are characterized by full thickness injury and damage to the muscle, bone or supporting structures, so the lack of subcutaneous fat layers makes a progression of pressure ulcers from stage two to stage three or four<sup>(8)</sup>.

Pressure ulcers continue to be a safety concern in today's healthcare systems due to the significant impact on patient

outcomes and cost of treatment that represent a major burden of sickness and reduced quality of life for patients. Additionally, they are associated with psychological and physical suffering, increased morbidity and mortality rate <sup>(2)</sup>.

Management of pressure ulcer emphasis that, 'prevention is better than cure' therefore, SKIN care bundle, educational program for patient, family and health staff, are considered as an essential components of pressure ulcer prevention practice for nurses to combat the incidence of PUs based on adequate knowledge and practice for its prevention as well as through identification, prediction of the patient that are at risk of getting a pressure ulcer through using of Braden scale <sup>(9)</sup>.

SKIN bundle is an evidence-based checklist to assist nursing staff in implementing pressure ulcer preventions, which is a collection of interventions, usually no more than five evidence-based practices, or precautionary steps, that may be applied to the management of a particular condition, or as preventative measures to reduce the risks of complications <sup>(10)</sup>. Components of this bundle concise in an abbreviations, that include "S" support surface, "K" keep turning every two hours for preventing ischemia of soft tissue, "I" improve moisture management/incontinence management for maintaining skin integrity and "N" Nutritional management for promoting wound healing and preventing pressure ulcer development <sup>(11)</sup>. Therefore, nurses must be educated about the bundle elements to achieve positive patient outcomes because recent developments in the area of PU prevention and management have focused on education <sup>(12)</sup>.

#### **Research hypothesis:**

- 1- There will be a significant improvement in the post mean knowledge scores of nurses at pediatric intensive care unit who are exposed to a designed SKIN care bundle protocol.
- 2- There will be a significant improvement in the post mean practice scores of nurses at pediatric intensive care unit who are exposed to a designed SKIN care bundle protocol.
- 3- There will be a significant reduction in pressure ulcer incidence at pediatric intensive care unit after the implementation of a designed SKIN care bundle protocol.

## **MATERIAL AND METHODS**

### **I- Materials:**

#### **Design:**

A quasi-experimental research design was utilized in this study.

#### **Setting:**

The study was conducted at the Pediatric Medical Intensive Care Units affiliated to Mansoura University Children's Hospital (MUCH) and international Hospital of Sandouh in El - Mansoura City, Egypt.

#### **Subjects:**

The study included a convenience sample of 84 nurses working at the above mentioned study setting regardless of

their age and qualification or years of experience & a convenience sample of 105 pediatric intensive care unit patients, recruited for six months' period

#### **Tools:**

#### **Tool I: A structured questionnaire sheet for nurses (pre, post & follow up format):**

It was designed by the researcher in a simple Arabic language after reviewing the related literature. It composed of 41 multiple choices questions that were collected by the researcher through an interview with nurses to assess their knowledge about all aspects of SKIN care bundle for pressure ulcer in PICU. It comprised of two parts as follows:

**Part (1):** Concerned with characteristics of the he studied nurses such as age, sex, level of education, years of experience in pediatric intensive care unit, and previous attendance of training program about SKIN care bundle.

**Part (2):** Concerned with nurse's knowledge about SKIN care bundle and pressure ulcer. It composed of 41 multiple choices questions, which covered the following items:

- Definition of SKIN care bundle and it's components to be implemented
- Pressure ulcer development factors
- Common sites of pressure ulcer among children
- Negative outcomes of pressure ulcer on children
- Risk assessment methods
- Skin care
- Nutrition to maintain healthy skin
- Dealing with mechanical load
- Pre discharge instructions

The scoring system for the questionnaire was developed; correct complete answer was given a score two, while correct incomplete answer was given a score one and zero was given for incorrect, missed or unknown answer. Insufficient knowledge was considered if the percent score was < 60 %, good sufficient knowledge from 60 % - < 80% and excellent sufficient knowledge if the percent score was 80% - 100%

#### **Tool II: Observational checklists for nurses (pre, post & follow up format):**

It was adopted from <sup>(13, 14)</sup> and translated by the researcher in simple Arabic language to assess nurse's performance as regarding care for pressure ulcer in critically ill pediatric patients. It comprised of the following parts:

#### **Part (1): A checklist of a designed SKIN care bundle protocol:**

It was adopted from <sup>(13)</sup> that was translated into Arabic language by the researcher. It was composed of four main sub items, which were:

- Surface (e.g., surface support through selection for type of mattress according to trust guidelines, linens of bed and use of pillow)
- Keep turning (e.g., Reposition patient every --- hrs when in bed (minimum every 2 hours, while at maximum every 4 hours)
- Incontinence care (e. g: Establish a skin care routine with timely cleansing of soiled and wet skin and use of incontinence products and fecal management systems)

- Nutrition (e. g: assess nutritional deficit, weight loss, hydration status and nutritional supplements)

**Part (2): A checklist for weight measurement in children:**

It was adopted from <sup>(14)</sup> that was translated into Arabic language by the researcher. It was discussed of two main sub items:

- Weight measurement for young children less than 2 years old
- Weight measurement for children older than 3 years old

The scoring system for the observation checklist was developed; in which each checklist step was coded as completely done, incompletely done or not done. Each completely done choice was given a score (2), incompletely done was given a score (1), and (0) score was given for the not done item, and accordingly the nurses' level of practice was considered unsatisfactory practice if the percent score was > 60%, good satisfactory practice from 60 % -< 80% and competent satisfactory practice if the percent score was 80 % -< 100%

**Tool (III): Children's assessment sheet (pre, post & follow up format):**

It was developed by <sup>(15)</sup> and adapted by the researcher, who translated it in simple Arabic language after reviewing the related literature to evaluate children's status as regard to development of pressure ulcer based on the clinical data before and immediately after implementation of the study program, as well as at follow up after 3 months. It comprised of two parts as the following:

**Part (1) :** It concerned with demographic and health characteristics of the studied critically ill children admitted in PICU such as age, sex, residence and medical data that related to patient's status such as diagnosis, risk factors, level of consciousness, degree of mobility, presence of soiling, restricted devices and history of pressure ulcer. The data were collected by the researcher through reviewing the child's medical record.

**Part (2): Braden scale risk assessment tool (pre / post and follow up):**

It was adopted from <sup>(15)</sup> and translated into Arabic language by the researcher who collected the required data through direct observation for pediatric patients, using concurrent Braden scale items. It was consisted of seven subscales that evaluated a patient's:

- Sensory perception (e.g: Ability to respond developmentally in appropriate way to pressure related discomfort)
- Activity level (e. g: The degree of physical activity).
- Mobility (e. g: The ability to change and control body position).
- Nutrition status (e. g: Usual food intake pattern).
- Skin exposure to moisture (e. g: Degree to which skin is exposed to moisture).
- Friction and shear forces (e. g: .degree of skin friction with linens).
- Tissue perfusion & oxygenation.

**Scoring system:**

Scores were distributed for measuring the severity of risk for developing pressure ulcer, in which each sub- item was

scored from 1 to 4. Score (4) representing the lowest level of risk of developing pressure ulcer, while score (1) indicating the highest risk of developing pressure ulcer. The total estimated score for any child was ranged from 7 (the highest risk of developing pressure ulcer) to 28 (no risk of developing pressure ulcer), which categorized into:

- No risk of developing pressure ulcer with the score ranged from 26 to 28.
- Mild risk with the score ranged from 22 to 25.
- Moderate risk with the score ranged from 17 to 21.
- High risk with the score ranged from 7 to 16.

**The educational training program about SKIN care bundle for critical care nurses at PICU:**

The investigator designed the training program based on the actual need assessment of the studied nurses through reviewing the related literature. The training program was containing the theoretical and practical skills related to SKIN care bundle and its application. The training program aims to improve the nurses' knowledge and practices about SKIN care bundle at PICUs.

The program was implemented in the PICU where the nurses are grouped in small groups; (6- 8 in each group). It was given in four sessions; two theoretical and two practical session. The time of each didactic sessions took between 30 – 60 minutes and each practical sessions took between 45 – 90 minutes. The program was given for a period of 12 weeks. Different method of teaching was used in the form of lectures, group discussion, demonstration and re-demonstrations. The educational program was presented in different way in the form of colored booklet, power point, video and hand out guideline. The program was carried out in the pediatric intensive care unit. Nurses' knowledge and practice were evaluated three times pre / immediate post and three months later after implementation of the training program using the previously mentioned study tools.

**METHOD**

An official permission was obtained by submission of an official letter to the director of the hospital and the head of pediatric intensive care unit of the mentioned setting to conduct the study after explaining the aim of the study. The tools were developed by the researcher, after reviewing of the related literature.

The developed tool was submitted to a jury of five experts in the pediatric nursing field for its content validity. Based on their comments; necessary modifications were done. The reliability of the tools was done by measuring the internal consistency of its items using the Alpha Cronbach's coefficient. The alpha reliability for three tools: tool 1 was reliable as  $r = 0.776$ , tool II was reliable as  $r = 0.976$  as well as tool III was reliable as  $r = 0.87$  (0.78).

Data collection of this study was carried out for six months in the period from the first of October 2016 to the end of March 2017. A pilot study was carried out on 9 nurses and 11 of pediatric patients in PICU (10% of the total sample size, to ascertain the feasibility, applicability and clarity of the tool and no modifications were done on the tools.

**Ethical Considerations:**

Approval was obtained from Research Ethics Committee at the Faculty of Nursing - Mansoura University. Informed consent was obtained from every nurse after explaining the aim of the study. Confidentiality of data and anonymity as well as nurses' right to withdraw from the study at any time was ascertained.

**Analysis of Data:**

The data were coded and entered in a data based file using the Statistical Package of Social Sciences (SPSS) version. Descriptive statistics (number, percentage, mean & SD) were used to describe the main variable. Association between categorical variables was tested using Chi-square test. All tests were performed at a level of significance of 5% (P < 0.05).

**RESULTS**

Concerning characteristics of the studied nurses. **Table (1)** revealed that, 28.6 % of the studied nurses were in the age group from 30 to less than 35 years of age. As regards to years of experience, 33.3% of the studied nurses were had 1 to less than 5 years of experience. In addition, the majority of the studied nurses (81%) did not receive any training program about SKIN care bundle for pressure ulcer prevention.

In relation to the total nurse's knowledge about pressure ulcers and SKIN care bundle. **Table (2)** clarified that, 36.9% of the studied nurses had an insufficient knowledge before conducting the program. While it improved to become 71.4% & 35.7% good sufficient knowledge immediately after the program and at follow up respectively, with a very high statistical significant differences at p<0.001.

As regards nurse's total practice about SKIN care bundle and weight measurement in PICU. **Table (3)** illustrated that, there was a highly statistical significant differences between before and immediately after as well as between

immediately after and post 3 months of the program implementation at p < 0.001. It was noticed that, 53.6% of the studied nurses had an unsatisfactory practice before and after 3 months of the program implementation, which decreased to 10.7% immediately after, while 38.1% of them had good satisfactory practice pre program implementation, which improved to 51.2% & 31% immediately after & at follow up respectively.

Regarding the number & percentage distribution of Braden risk assessment categories among pediatric patients in ICU. **Table (4)** demonstrated that, 78.1% of the studied pediatric patients had a high risk for Pus development before program implementation, which decreased to 14.3% and 40% immediately after & at follow up respectively, with a very highly statistical significant difference between pre, immediate post & post 3 months of program implementation at p < 0.001.

As regards the relation between general characteristics of the studied nurses & their total knowledge about pressure ulcers and SKIN care bundle before, immediately after and post 3 months of the program implementation. **Table (5)** indicated that there was a significant negative relation between characteristics of the studied nurses' & their total knowledge about pressure ulcers and SKIN care bundle before, immediately after and post 3 months of the program implementation, except nurses' age, in which there was a significant positive relation between nurse's age and their total knowledge about pressure ulcers and SKIN care bundle at p< 0, 05 at the immediate post of the program implementation

Demonstrating association between nurses' knowledge and practice before and immediately after & post 3 months of the program implementation. **Table (6)** showed that, there was a significant positive association between nurses' knowledge and practice pre, immediately after and at follow up with a highly statistical significant differences at p<0.001

Table (1); Characteristics of the studied nurses (N=84)

Characteristics	Number	%
<b>Age in years</b>		
20 < 25	22	26.2
25 < 30	20	23.8
30 < 35	24	28.6
35 < 40	18	21.4
X = SD	29.30 ± 5.82	
<b>Years of experience in PICU</b>		
< 1	4	4.8
1 < 5	28	33.3
5 < 10	24	28.6
10 & more	28	33.3
X ± SD	7.61 ± 5.02	
<b>Attending of training programs about Pus</b>		
No	68	81

Table (2); Number and percentage distribution of total nurses' knowledge about pressure ulcer and SKIN care bundle (N=84).

Nurse's knowledge		Pre		Immediate post		Follow up (post 2)		Wilcoxon signed rank test		
		N	%	N	%	N	%	Z1	Z2	Z3
Insufficient		31	36.9	8	9.5	44	52.4	Z1= -3.705 P1<0.001*	Z2= -2.222 P2= 0.026*	Z3= -5.018 P3<0.001*
Sufficient	Good Excellent	44 9	52.4 10.7	60 16	71.4 19.0	30 10	35.7 11.9			

(\*) Statistically significant at P<0.05  
 Z& p1=differences between before & immediately after  
 Z& p2=differences between before & follow up

Table (3); Number and percentage distribution of total nurses' practice about SKIN care bundle & weight in PICU (N=84).

Nurse's practice		Pre		Immediate post		Follow up (post 2)		Wilcoxon signed rank test		
		N	%	N	%	N	%	Z1	Z2	Z3
Unsatisfactory		45	53.6	9	10.7	45	53.6	Z1= -3.927 P1<0.001*	Z2= -0.475 P2= 0.635	Z3= -4.571 P3<0.001*
Satisfactory	Good Competent	32 7	38.1 8.3	43 32	51.2 38.1	26 13	31.0 15.5			

Table (4): Different levels or categories of Braden risk assessment in percentage distribution among pediatric patient in ICU (N= 105).

Risk assessment categories	Pre		Immediately after		Post 3 months		Wilcoxon signed rank test		
	N	%	N	%	N	%	P1 <0.001*	P2<0.002*	P3 <0.001*
Mild risk	5	4.8	24	22.9	22	21			
Moderate risk	18	17.1	66	62.9	32	30.5			
High risk	82	78.1	15	14.3	42	40			
No risk	0.00	0.00	0.00	0.00	9	8.6			

Table (5): Relationship between general characteristics of studied nurses' and their total knowledge score pre, immediately after and at follow up of the program implementation (N= 84).

Variables	Total knowledge									Test of significance		
	Before			Immediately after			Post 3 months			χ <sup>2</sup> <sub>1</sub> & P	χ <sup>2</sup> <sub>2</sub> & P	χ <sup>2</sup> <sub>3</sub> & P
	Insufficient %	Good sufficient	Excellent sufficient %	Insufficient %	Good sufficient	Excellent sufficient %	Insufficient %	Good sufficient %	Excellent sufficient %			
<b>Age in years</b>												
20 < 25	19.4	32	22.2	25.0	28.3	18.8	25.0	23.3	40.0	5.516 0.480	13.540 0.035	3.747 0.711
25 < 30	22.6	20.5	44.4	25.0	21.7	31.3	20.5	30.0	20.0			
30 < 35	38.7	22.7	22.2	50.0	20.0	50.0	27.3	33.3	20.0			
35 < 40	19.4	25.0	11.1	0.0	30.0	0.0	27.3	1.3	20.0			
<b>Educational level</b>												
Diploma	51.6	36.4	22.2	37.5	40.0	43.8	45.5	36.7	30.0	3.614 0.461	3.837 0.429	4.953 0.292
Technical institute of nursing	19.4	20.5	33.3	37.5	23.3	6.3	22.7	13.3	40.0			
Bachelor degree of nursing	29.0	43.2	44.4	25.0	36.7	50.0	31.8	50.0	30.0			

Years of experience in PICU												
< 1	0.0	6.8	11.1	0.0	5.0	6.3	4.5	3.3	10.0	7.195	9.150	2.191
1 < 5	35.5	34.1	22.2	37.5	35.0	25.0	29.5	36.7	40.0	0.303	0.165	0.901
5 < 10	25.8	25.0	55.6	50.0	20.0	50.0	27.3	30.0	30.0			
10 & more	38.7	34.1	11.1	12.5	40.0	18.8	38.6	30.0	20.0			
Attending of training programs about Pus No	83.9	79.5	77.8	87.5	80.0	81.3	88.6	66.7	90.0	0.867	0.879	0.045

Table (6): Association between nurses' knowledge and practice (pre/post/post 3 months).

Variables	Know pre		Know post		Know FU	
	R	P	R	P	R	P
practice pre practice post practice FU	0.271	0.013*	0.383	<0.001*	0.390	<0.001*

**DISCUSSION**

Pressure ulcers (PUs) represent a widespread problem and are amongst the most common iatrogenic, reportable events associated with healthcare as well as causing pain, infection and prolonged hospitalization, particularly among critically ill patients (Visscher & Taylor, 2017) <sup>(16)</sup>. However, the problem of PUs in adults has received a great deal of attention, far less is known about PUs in neonates and children. Critically ill pediatric patients in the intensive care unit (ICU) are a unique, vulnerable group at high risk of skin damage as a result of Multiple factors including underlying acute and chronic disease processes, immobility, age, body mass index (BMI), impaired sensory perception, altered tissue perfusion and malnutrition (Bucknall et al., 2016) <sup>(17)</sup>.

The mechanism of pediatric pressure ulcer formation is similar to the mechanism in adults, but the most common sites for pressure ulcer development are different because of physiological differences in infants and children, for example, the head makes up a greater proportion of the total body weight and surface; thus, the occipital region of the scalp is the most common site of ulceration for infants and children (Martha et al., 2018) <sup>(4)</sup>.

Pressure ulcer prevention is multifaceted and requires skills, knowledge and consistency in nursing practice. Risk assessment, skin assessment, repositioning and pressure relief measures are integral components of effective prevention of PUs in children (Levy, Kopplin & Gefen, 2017) <sup>(18)</sup>.

Moreover skin care bundle' plans for prevention of pressure ulcers incorporates the interventions as minimize pressure through providing support for specific body areas or for distributing pressure evenly, keep turning of child every two hours, improve moisture management, maintain adequate nutrition / hydration (Higer & James, 2017) <sup>(19)</sup>. Of course the prevention of PUs has generally is considering the responsibility of nursing staff as well as all nurses should be at the forefront of predicting patients at risk for PUs. Healthcare professionals need to be able to benchmark the care they deliver against standards that ensure the patient receives the best possible care (Peterson et al., 2015) <sup>(20)</sup>.

The finding of the current study revealed that, more than one quarter of the studied nurses were in the age group from 30 to less than 35 years of age (Table 1). This result was incongruence with Diab (2015) <sup>(21)</sup> who conducted a study about "effect of educational guideline on prevention of skin breakdown in pediatric intensive care unit at Al- Jouf city" and stated that, the vast majority of nurses were within the age of 26 to 30 years. From the researcher point of view, this finding of the current study might be due to nurses at this age were not a newly graduates & they were at the middle age of their working carrier.

Concerning the total nurses' knowledge about pressure ulcer & SKIN care bundle (table 2). The study showed that, the minority of nurses had an insufficient knowledge and more than half of them had good level of knowledge before program implementation. This finding was in an agreement with Tweed & Tweed, (2017) <sup>(22)</sup> who conducted a study about "nurses knowledge of pressure ulcer: Development of an assessment tool & effect of an educational program" and proved that, the majority of ICU nursing staff had a good level of knowledge of PUs & SKIN bundle before an educational program which improved at follow up of the educational program.

As regards nurse' total practice about SKIN care bundle and weight measurement in PICU, the finding of the current study illustrated that, more than half of the studied nurses had an unsatisfactory practice score before program implementation (table 3). This finding was in the same line with Nasreen, S. (2017) <sup>(23)</sup> who conducted a study about " nurses knowledge and practices toward pressure ulcer prevention in general children's hospital in Lahore" and reported that, the majority of ICU nursing staff had poor practice score before program implementation. While, this result was contradicted with Dilie & Mengistu, (2016) <sup>(24)</sup> who reported that the majority of nurses had a satisfactory practice score compared to more than one third of them had unsatisfactory practice score before training program

Regarding to the effect of Braden pressure ulcer risk assessment scale on pediatric critically ill patients in ICU

before implementation of the study program, immediately after and at follow up (**table 4**). The finding of the current study proved that, the majority of the studied pediatric patients had a high risk level of Braden PUs risk assessment before program implementation, which decreased immediately post an at follow up (**table 4**). This finding was identical with **David et al., (2015)** <sup>(25)</sup> who conducted a study about "mastering pressure ulcer risk assessment with the pediatric pressure ulcer prediction and evaluation tool" and he stated that, higher percentage of children had a high risk category for PUs before providing intervention.

On the contrary, this finding was uncoordinated with **Stuque, Silva, Araujo, Oliveira & Falcao, (2017)** <sup>(26)</sup> who found in (**table 4**) that, more than half of the pediatric patients were shown to have moderate risk for PUs development according to Braden PUs risk assessment before application of pressure ulcer' care protocol in ICU. The researcher suggested that result might be related to nurses' knowledge deficit and lack of training about Braden risk assessment scale for children

As regards the relation between educational level and years of experience of the studied nurses and their total knowledge score pre, immediate post & post 3 months of program implementation (**table 5**). These findings cleared that, there was a negative relation between the previously mentioned characteristics and their total knowledge score about PUs & SKIN bundle. Similarly, **Gupta, Loond & Leon, (2017)** <sup>(27)</sup> who conducted a study about "comparing & contrasting knowledge of PUs assessment, prevention & management in children among nursing staff working in ICU" and emphasized that, there was no significant difference based on years of experience among nurses for PUs prevention at (P<.2).

While, the previous finding was contradicted with **Nuru, Zewdu, Amsalu & Mehretie, (2016)** <sup>(28)</sup> who stated that, level of education, length of work experience were found to have a significant and independent effect on nurses' knowledge regarding Pus prevention at P<0.05

In relation to association between nurses' knowledge and practice before and immediately after & post 3 months of the program implementation, the result of the same study proved that, there was a significant positive association between nurses' knowledge and practice pre, immediately after and at follow up with a highly statistical significant differences at p<0.001 (**table 6**). This result was in contradiction with **Islam, (2017)** <sup>(29)</sup> who emphasized that, there was a significant negative correlation between nurses' knowledge and practice regarding PUS prevention at r=, 14 & p>0.05 before and after training program. This result reflect that, nurses' knowledge act as an important and independent factor in carrying out practice regarding Pus prevention

## CONCLUSION & RECOMMENDATION

It was concluded that, the program had a positive effect on the critical care nurses' knowledge & practices as represented by a significant improvement in the post mean knowledge and practice scores of nurses at pediatric intensive care unit as well as on the pediatric intensive care

unit patients as represented by a decrease in percentages of the studied pediatric patients who had a high risk for PUs development to immediately after & at follow up program implementation respectively. The study recommended including SKIN care bundle interventions & Braden risk assessment into nurses' routine care and developing regular and continuous educational programs for the critical care nurses according to their needs aiming at refreshing their knowledge and improving their practice for critically ill pediatric patients

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