Effect of Implementing Evidence Based Nursing Guidelines on Nurses' Performance and Clinical Outcomes for Children Undergoing Stem Cells Transplantation

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Abstract

Background

Evidence based guidelines during stem cells transplantation process provides nurses with the high quality of nursing care to help them to make well-founded decisions and reduce patient's expected complications**. Aim of the study:** was to determine the effect of implementing Evidence Based Nursing Guidelines on nurses' performance and clinical outcomes of children undergoing stem cells transplantation**. Subjects and Method:** A quasi-experimental research design was utilized for a convenience sampling of 30 nurses working at Bone Marrow Transplantation Unit of Tanta Universal Educational Hospital and 20 children undergoing stem cells transplantation. **Tools of data collection:** Three tools were used to collect data**:** Structured interview schedule to assess nurses' knowledge about stem cell transplantation, Evidence Based Nursing Practice regarding care of children undergoing stem cells transplantation and children's clinical outcomes assessment sheet. **Results**: All nurses had low level of knowledge about stem cells transplantation and high percentage of them had unsatisfactory practice regarding care of children undergoing stem cells transplantation before Evidence Based Nursing Guidelines' implementation, whereas immediately and one month after ,nurses' total scores of knowledge and practice improved .**Conclusion**: there was a highly statistically significant improvement in nurses' total scores of knowledge and practice with statistically significant improvement in the children's outcomes. **Recommendations*:*** Continuous implementation of evidence based nursing guidelines for nurses caring of children undergoing care of children undergoing stem cells transplantation.

Key words: Children, Clinical outcomes, Evidence Based Nursing Guidelines, Nurses' performance, Stem cell transplantation.

Introduction

Hematopoietic Stem Cell Transplantation known as Bone Marrow Transplantation (BMT) is a life expectancy treatment for several incurable disorders nowadays as the survival rate following the operation has grown.[1,2] It's uses has expanded to patients with fatal diseases other than cancer to autoimmune diseases, inherited skeletal dysplasia and malignant infantile osteoporosis. [3]

Hematopoietic Stem Cells Transplantation (HSCT) is a medical treatment that restores healthy bone marrow to patients whose bone marrow has been destroyed by disease or chemotherapy. [4]This operation includes transfusion of healthy hematopoietic stem cells usually collected from bone marrow, peripheral blood, or umbilical cord blood which migrate to bone marrow where they

can produce new blood cells and enhance engraftment of new bone marrow. [5]

The transplant rate in pediatrics from 1984 to 2011 in eight countries was 5187 transplants of which 4513 (87%) were allogeneic and 674 (13%) were autologous. The largest number of transplants during this period were performed in Saudi Arabia with a total of 1977 transplants (38.2%) followed by Iran (*n*=1197, 23.1%), Egypt (*n*=811, 15.6%), Jordan (*n*=361, 7%), Pakistan (*n*=325, 6.2%), Tunisia (*n*=249, 4.8%), Oman (*n*=162, 3.1%) and Lebanon (*n*=105, 2%). [6] Nasser Institute is the first and largest centre for hematopoietic stem cell transplantation in Egypt with 20 cabins outfitted with High Efficiency Particulate Air (HEPA) filters, positive pressure, and vertical laminar air flow. [7, 8]

Hematopoietic Stem Cell Transplantation can be classified into three types which are autologous, syngeneic and allogeneic transplant. Autologous transplant; occurs when the child get the stem cells from himself or herself while in syngeneic transplant the child receive the healthy bone marrow from their identical twins and a more difficult transplant known as allogeneic, in which the child receives the stem cells from a healthy donor who is Human Leucocytes Antigen (HLA) compatible with him or her.[9] The ideal donor of stem cell in allogeneic transplantation is fully matched Human Leucocytes Antigen related donor (sibling from the same parents of the child) [10].

Preparation therapy called Conditioning therapy is most crucial in preparing the child for transplantation which administered various days prior the infusion of stem cell. It comprises utilizing different protocol regimens of chemotherapy, radiation, and/or immunotherapy. Alternatively, the pre hematopoietic stem cell transplantation conditioning can be chemotherapy only without radiation. It used for eradication of disease, generate a space in childs' bone marrow for engraftment of new stem cells and act as immunosuppressant to decrease the risk of rejection of stem cells by the host cells.[11]

There are many complex complications from allogeneic stem cell transplantation which cause multiple readmissions to hospital as infection and rejection of new stem cells called Graft Versus Host Diseases (GVHD) and psychological complications include anxiety, stress and depression. [12] GVHD can only develop after allogeneic hematopoietic stem cell transplantation in children who get a transplant from a histocompatible related or unrelated donor in human leukocyte antigen typing. It happens when the T lymphocytes of donor's cells fails to recognize the recipient's cells and start to attack the recipient's tissues. [13]

The child needs extra care throughout the preparation with conditioning regimens to avoid difficulties with transplantation.[14]

Nurses should be oriented with the potential complications in order to prevent or discovering the warning signs as sepsis, fluid overload, organ malfunction and take the necessary actions to reduce negative consequences and restore the child's clinical status. [14, 15] Prior to discharge, nurses also give the children and their families' intensive instruction on post stem cells transplantation restrictions, food, medications, fluid balance, test results, care of catheter and the importance of follow-up. As a result, this care is extremely difficult and demands advanced nursing skills and abilities. [15]

Nurses should always ensure that their information and practice regarding stem cells transplantation are updated in order to perform safely and competently at all times.

[16] As a result, it's critical that competency and training programs are organized, ongoing and supported by evidence based implementation to give nurses the scientific information they need to make informed judgments and minimize anticipated child's consequences. [17]

Evidence Based Practice (EBP) refers to the application of interventions and techniques whose efficacy has been verified by research. [18] The ultimate objectives of evidence-based nursing practice are to advance high-quality treatment that is informed by research and knowledge as well as cost-effective results for patients, healthcare professionals and the health care system.[19,20]

Nurses have a critical role in ensuring Evidence Based Nursing Guidelines (EBNGs) in care provided for children who gets stem cell transplantation and in the prevention, management of complications which begins with sustaining a highest quality of care while isolating the child with highly strict infection control precautions, delivery of intravenous chemotherapy and immunosuppressant safely, maintaining the hemodynamic state, managing complications and making the discharge plan. [21, 22]

Significance of the study

Hematopoietic Stem Cell Transplantation is a survival procedure which performed when child's bone marrow isn't healthy enough to produce the blood components as in cases of a plastic anemia, leukemia, lymphoma, sickle cell anemia and thalassemia. [3] It starts in Egypt since 1997 with the transplants rate of pediatrics per 10 million population was 109 transplants annually. [6]

The scope of nursing science in HSCT has shifted from considering symptoms, treatment and process improvement to high quality life and long-term mortality topics integrating children as much as possible in their healthcare decisions and emphasizing care. [2] Sometimes owing to a lack of information and inadequate practice, nurses are unable to provide modern or recent nursing care for children receiving stem cell transplants. [14]

Evidence Based Nursing Guidelines is the most effective standard for providing the high efficient nursing care. Implementing these guidelines on children undergoing stem cells transplantation is not only a vital step for nursing practice but it also has a major impact for nursing science. Additionally, it is important to give children complete, comprehensive information they need to ensure the little degree of discomfort throughout the various stages of stem cells transplantation and minimize the possible complications. [23]

Aim of the Study

The aim of this study was to determine the effect of implementing evidence based nursing guidelines on nurses' performance and clinical outcomes of children undergoing stem cells transplantation.

Research Hypotheses

1-Implementing Evidence Based Nursing Guidelines for nurses working at bone marrow transplantation unit are expected to improve their performance.

2- Clinical outcomes of children undergoing stem cells transplantation are expected to be improved after implementing stem cells Evidence Based Nursing Guidelines.

Subjects and Method

Research design: Aquasi-experimental research design was used.

Setting: The study was conducted at the Bone Marrow Transplantation unit of Tanta International Educational Hospital which is affiliated to the Ministry of Higher Education and Scientific Research which consists of two zones (outer and inner zone)

-**The outer zone consists** of five rooms which includes (Secretory office, clinical pharmacy, meeting room, laboratory for storage of stem cells and preparation of chemotherapy, laboratory for separation and apheresis of stem cell and for storage of blood and its components.

-**The inner zone consists** of three red lines: first line consists of one post-transplant room that contains two beds, second line consists of two intermediate rooms each room contains one bed, third line consists of four isolation rooms (capsule), each capsule consists of two parts first one called (ante room) for preparation of medication and second one contain bed for the child, television and bathroom.

Subjects

- All available nurses (30 nurses) who provide direct care for children at the previously mentioned setting were involved in the current study.

-A purposive sample of 20 children who admitted to bone marrow transplantation unit for stem cells transplant.

Inclusion criteria of children include

-Age from 1-16 years.

-Both sexes.

-Diagnosed with any of the following diseases: thalassemia, severe aplastic anemia, and lymphoma.

- Children have donors matched with their Human Leucocyte Antigen.

-Free from the following diseases: tumors and immune, liver, cardiopulmonary, brain diseases.

Tools of data collection

Three tools were used to collect the study data:

Tool I: Bio-sociodemographic characteristics and structured interview schedule: It was developed by the researcher based on relevant literatures [24, 25] to assess nurses' knowledge about stem cell transplantation and consisted of the following parts:

Part (1): Socio-demographic data of the studied nurses as age, sex, level of education, place of work, years of experience and attendance of any training programs related to stem cell transplantation

Part(2):Socio-demographic characteristics of the studied children as age, sex, birth order, number of family members and residence.

Part (3): Medical history of the children as past and present medical history, family history, diagnosis and duration of receiving blood.

Part (4): Nurses' knowledge about stem cell transplantation: It contained; sites, function of bone marrow, types, steps of stem cells transplantation and its blood disorders, nursing care before, during and after stem cell transplantation, during complications and infection control precautions.

The questionnaire contained 46 questions. The grades ranged from (0-2) for each question. Correct complete answer was scored 2; incomplete correct answer was scored 1 and zero for incorrect or didn't know answer.The sum of all questions was 92.

Total scoring system for nurses' knowledge was categorized as the following

-High level of knowledge was considered from 80 % and more.

-Moderate level of knowledge was considered from 60 to less than 80%.

-Low level of knowledge was considered less than 60%**.**

Tool II: Evidence Based Nursing Practice regarding care of children undergoing stem cells transplantation observational checklists : It was developed by researcher based on relevant literatures [26-29] to

evaluate nurses' practice: before, during, after transplantation, during complications and discharge which included the following:

-Before stem cells transplantation process (35 items).

-During stem cells transplantation day (14 items).

-After stem cells transplantation (14 items) and during complications (38 items).

-Discharge education regarding care of the child after stem cells transplantation (13 items)**.**

Observational checklists consisted of 117 items; each item was scored from 0-2 grades. Correct complete done was scored 2; incomplete correct done was scored 1 and zero for incorrect or didn't do. The sum of all items was 234

Total scoring system for nurses' practice was calculated as

-Less than 80 % was considered unsatisfactory practice.

-From 80 % to 100% was considered satisfactory practice.

Tool III: Children's clinical outcomes assessment checklist: This tool was developed by the researcher after reviewing of related literatures [23,28,30] .It was used to assess Children's' clinical outcomes and their early and late complications after stem cells transplantation.

Method

- The research was achieved through the following phases:

1-Adminstrative process

The researcher got an official permission from Faculty of Nursing, Tanta University and also from the administrators of Bone Marrow Transplantation Unit at Tanta Universal Educational Hospital to facilitate performance of the study.

2-Ethical and legal considerations

Nurses were informed about the confidentiality of the information obtained from them .The nature of the study didn't cause any harm or pain to the entire subjects. Nurses' oral consent was obtained to participate in the study after explanation of the aim& benefits by the researcher.

3-Tools development

The researcher developed three study tools based on recent and evidence-based literatures. Structured Interview Schedule (Tool I) and Observational Checklists (Tool II) and Children's Clinical Outcomes Assessment Checklists (Tool III).

4-Content Validity

Tools of the study were tested for content validity by five experts in the field of pediatric nursing, modifications were carried out accordingly and the content validity index was 98%.

5-Content Reliability

A Pilot study was conducted to test the reliability of tools (high reliability: Cronbach's alpha was 0.951).

6-Pilot study:

The researcher assessed the clarity, visibility, and applicability of the research tools by conducting a pilot study on 10% of the nurses (3 nurses) and necessary adjustments were made. Pilot study was excluded from the study sample.

7- **The study steps**

The steps of Evidence Based Practice were conducted through the following phases:

1- Assessment phase:

Assessment of nurses' performance regarding stem cells and clinical status of children undergoing stem cells were done using study tools (I, II and III) three times: before, immediately and one month after the implementation of evidence based nursing guidelines through ;interview with nurses in bone marrow transplantation unit. All nurses were observed during different nursing procedures related to care for children

undergoing stem cells transplantation at morning and afternoon shifts.

2- Planning phase

Educational guidelines were planned according to nurses' needs assessment and based on literatures reviews which were focused on setting the objectives. Content preparation was included the rational for implementing the sessions. The educational guidelines were translated into Arabic. A variety of teaching materials were used as interactive lecture, demonstration and re-demonstration, video tape, power point and poster presentation for the evidence based nursing guidelines

3- Implementation phase

Nurses were divided into 6 subgroups: Each group consists of 5 nurses. Evidence Based Nursing Guidelines had been presented to all nurses included in the study in 8 sessions for each group; each session take from 45-60 minutes due to the largest volume of content. The sessions covered the following topics:

First session

It focused on; definition, sites function, sources and types of bone marrow, the most common blood disorders which treated with stem cells transplantation.

Second session

It focused on; definition, types, indications and steps of stem cells transplantation, important tests needed before stem cells transplantation.

Third session

It focused on explanation of the Evidence Based Nursing Guidelines before stem cells transplantation.

Fourth session It focused on explanation of the Evidence Based Nursing Guidelines during the day of stem cells infusion.

Fifth session

It was about the signs and symptoms of rejection (Graft Versus Host Disease) and infection after stem cells transplantation.

Sixth session

It focused on nursing care after transplantation, wound care, nutritional intake assessment and administration of immunosuppressive drugs.

Seventh session

It focused on infection control measures related to stem cell transplantation and health education about complications after stem cells transplantation.

Eighth session

It focused on discharge education about; infection control measures follow up times, fluid intake and diet restriction, manifestation of GVHD and infection.

Evaluation phase

Evaluation of the effectiveness of implementing Evidence Based Nursing Guidelines on nurses' knowledge, practice and clinical outcomes of children undergoing stem cells transplantation was performed three times; before, immediately and after one month by the same study tools.

Statistical analysis

The collected data were organized, tabulated and statistically analysed using SPSS software statistical computer package version 26. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison was done using Chi-square test (χ^2). For comparison between means of two variables in a group, paired samples t-test was used. For comparison between means for variables during three periods of intervention in a group, or for more than two variables, the F-value of analysis of variance (ANOVA) was calculated.

Correlation between variables was evaluated using Pearson and Spearman's correlation

coefficient r. A significance was adopted at P<0.05 for interpretation of results of tests of significance (*). Also, a highly significance was adopted at P<0.01 for interpretation of results of tests of significance (**).[31]

Results

Table(1):Demonstrates socio-demographic characteristics of studied nurses. It was observed that, 73.3% of them aged from 25 to less than 30 years with the mean age score (**28.50±1.456**) years and were females. In relation to the level of education, it was evident that, 63.3% of nurses had bachelor of nursing while 36.7% of them had technical health institute.

As regards the years of experience, it was cleared that 83.3% of nurses had less than five years of experience at bone marrow transplantation unit, while 16.7% of them had experience from 5 years to less than 10 years .Also 80% of them hadn't any training programs related to bone marrow transplantation.

Table (2): Represents Socio-demographic characteristics of children, It was observed that 45% of them their age was ranged from 5 to less than 10 years old with the mean age **(8.57±5.094)** years while 30% of them ranged from 3 to less than 5 years and 25% of them aged more than 10 to less than 15 years .Also 55% of them were males and had a family consisting of 5 members In addition, 80% from them were the second child in the family and 85% of them lived in rural areas while 15% from urban areas.

Table (3): Shows medical history of children. It was observed that 75% of them were diagnosed as thalassemia and 15% were diagnosed as aplastic anemia while 5% were diagnosed as lymphoma and pure red cell aplasia. All of them had no past history of health problems related to bone marrow and were received previous blood contents (packed RBCs) .Also 95% of them had no presence of any family history related to bone marrow diseases.

Table (4): Clarifies the total levels of nurses' knowledge about stem cell transplantation. It was revealed that, the highest mean score was during immediate phase (**57.60±1.632**) then after one month (**52.50±0.820**) from EBNGs implementation. There were highly statistically significant differences during three phases of the EBNGs with χ^2=27.56, P1=0.000, χ^2=51.07, P2=0.000, χ^2=22.46, P3=0.000 before, immediately and after a month from EBNGs implementation**.**

Table (5): Clarifies the total level of nurses' practice regarding care of children undergoing stem cell transplantation**.** It was apparent that, before the EBNGs implementation the majority of nurses 96.7% had un satisfactory practice level while immediately after EBNGs implementation all of them (100%) had satisfactory level of practice and one month after implementation, 96.7% of them had a satisfactory practice level with highly statistically significance differences regarding total practice before, immediately and after one month with χ^2=68.67, P1=0.000, χ^2=57.33, P2=0.000,χ^2=21.33, P3=0.044.

Table (6): Show percentage distribution of the studied children according to their clinical outcomes. The study reveals that there was a highly significant improvement in the studied children's temperature, blood pressure, central venous pressure, intake and output and nutritional status and weight where χ^2=24.81, P=0.001,χ^2=25.00, P=0.000,χ^2=25.00, P=0.000 ,χ^2=25.00, P=0.000 ,χ^2=13.074, P=0.001, χ^2=20.00, P=0.000 respectively before, immediately

after and after one month from EBNGs implementation.

Also the study reveals that there was a highly statistically significant difference on reduction in the occurrence of low cell count (Pancytopenia) to the studied children with χ^2=7.921, P=0.001 before, immediately after and after one month from EBNGs implementation respectively.

Table (7): Shows percentage distribution of children related to signs of rejection for skin and gastrointestinal Graft Versus Host Diseases. The study reveals that there was a highly statistically significant difference on reduction in the occurrence of GVHD on skin and gastro intestinal tract (dry rashed skin, diarrhea) and oral mucositis on the studied children with χ^2=24.81, P=0.001,χ^2=13.074, P=0.001,χ^2=7.302, P=0.026, ,χ^2=7.302, P=0.026 before, immediately after and after one month from EBNGs implementation respectively.

Table (8): Shows percentage distribution of children related to their signs of infection. The study reveals that that there was statistically significant difference on reduction in the occurrence of signs infection on the studied children as hyperthermia, hotness, redness, swelling at site of Hickman with χ^2=16.232, P=0.000, χ^2=9.714, P=0.008, χ^2=9.714, P=0.008 respectively before, immediately after and after one month from EBNGs implementation .

Table (9): Represents correlation between total knowledge and total practice score among studied nurses. The study showed that, there was statistically significant positive correlation between total knowledge score and total practice score before, immediately and after one month from EBNGs implementation (r= 0.407, P= 0.026) (r=0.201, P= 0.001) (r= 0.137, P=0.013) respectively

Table (1): Percentage distribution of studied nurses' about socio-demographic characteristics (n=30):

Socio-demographic characteristics of the studied nurses	The studied nurses (n=30)	
	No	%
Age (in years)		
- 20 < 25	0	0
- 25 < 30	22	73.3
- ≥30	8	26.7
Range	**(25-32)**	
Mean ± SD	**28.50±1.456**	
Sex		
- Male	8	26.7
- Female	22	73.3
Educational level		
- Institute of technical health	11	36.7
- Bachelor of nursing	19	63.3
Years of experience in Bone Marrow Transplantation unit		
- <5	25	83.3
- 5< 10	5	16.7
Attendance of any training program related to Bone Marrow Transplantation		
- Yes	6	20.0
- No	24	80.0

Table (2): Percentage distribution of children's about socio-demographic characteristics (n=20):

Socio-demographic characteristics of the studied Children	Studied children (n=20)	
	No	**%**
Age (in years)		
- <5	6	30.0
- 5-10	9	45.0
- >10	5	25.0
Range	**(3-15)**	
Mean ± SD	**8.57±5.094**	
Sex		
- Male	11	55.0
- Female	9	45.0
Birth order		
- Second	16	80.0
- Third	4	20.0
Number of family members		
- Fourth	4	20.0
- Fifth	11	55.0
- Sixth	5	25.0
Residence		
- Urban	3	15.0
- Rural	17	85.0

Table (3): Percentage distribution of children's medical history (n= 20)

Children's medical history	Studied children (n=20)	
	No	**%**
Previous health problems related to bone marrow		
- No	20	100.0
Diagnosis		
- Thalassemia	15	75.0
- A plastic Anemia	3	15.0
- Non Hodgkin lymphoma	1	5.0
- Pure Red Cell Aplasia	1	5.0
Child receiving any previous blood contents		
- Yes		
- No	20	100.0
Type	0	0.0
- Packed red blood cells		
- Packed red blood cells and platelets	17	85.0
	3	15.0
Presence of any Family history related to bone marrow diseases		
- Yes	1	5.0
- No	19	95.0

Table (4): Total scores of studied nurses' knowledge regarding stem cells transplantation before, immediately and after one month from Evidence Based Nursing Guidelines' implementation(n=30):

Total knowledge levels	Studied nurses (n=30)						χ^2 P	χ^2 P1	χ^2 P2	χ^2 P3
	Before EBNGs implementation		Immediately after EBNGs implementation		After one month from EBNGs implementation					
	No	%	No	%	No	%				
- Low (<60%)	30	100.00	0	0.00	0	0.00				
- Moderate (60-<80) %	0	0.00	0	0.00	1	3.33	91.52 0.000*	115.97 0.000*	64.82 0.000*	71.04 0.000*
- High (≥80 %)	0	0.00	30	100.00	29	96.67				
Range	(22-38)		(55-61)		(51-54)		F=942.55	27.56	51.07	22.46
Mean ± SD	30.03±4.148		57.60±1.632		52.50±0.820		P=0.000*	0.000*	0.000*	0.000*

***Statistically significant difference at (P<0.05).**

P1: Before and immediately after EBN guidelines.

P2: Before and one month after EBN guidelines.

P3: Immediate and one month after EBN guideline.

Table (5): Total scores of studied nurses' practices about care of children undergoing stem cells transplantation before, immediately and after one month from Evidence Based Nursing Guidelines' implementation (n=30)

Total scores of studied nurses' practice related to care of children undergoing stem cell transplantation	Studied nurses (n=30) Total practice level						χ^2 P	χ^2 P1	χ^2 P2	χ^2 P3
	Before EBP guidelines implementation		Immediately after EBP guidelines implementation		After one month from EBP guidelines implementation					
	No	%	No	%	No	%				
▪ Unsatisfactory <80%	29	96.7	0	0.0	1	3.3	85.719 0.000*	68.67 0.000*	57.33 0.000*	21.33 0.044*
▪ Satisfactory ≥80 %	1	3.3	30	100.0	29	96.7				

***Statistically significant difference at (P<0.05).**

P1: Before and immediately after EBN guidelines.

P2: Before and one month after EBN guidelines.

P3: Immediate and one month after EBN guideline.

Table (6): Percentage distribution of children regarding their clinical outcomes.

Children's clinical outcomes	Studied children(n=20)						
	Before EBP guidelines implementation (n=6)		Immediately after EBP guidelines implementation (n=7)		After one month from EBP guidelines implementation (n=7)		χ^2 P
	No	%	No	%	No	%	
Temperature							
- Normal	0	0.0	5	71.4	5	71.4	**24.81**
- Hyperthermia	6	100.0	2	28.6	2	28.6	**0.001***
Pulse							
- Normal	3	50.0	6	85.7	6	85.7	2.857
- Tachycardia	3	50.0	1	14.3	1	14.3	0.240
Respiration							
- Normal	2	33.3	5	71.4	5	71.4	2.540
- Tachypnea	4	66.7	2	28.6	2	28.6	0.281
Blood pressure							
- Normal	2	33.3	7	85.7	6	85.7	**25.00**
- Abnormal	4	66.7	0	14.3	1	14.3	**0.000***
Central venous pressure							
- Normal	2	33.3	7	85.7	6	85.7	**25.00**
- Abnormal	4	66.7	0	14.3	1	14.3	**0.000***
Intake & output							
- Balanced	2	33.3	7	100.0	6	85.7	**25.00**
- Not balanced	4	66.7	0	0.0	1	14.3	**0.000***
Nutritional state							
- Normal	0	0.0	7	100.0	4	57.1	**13.074**
- Decreased appetite& Refuse to eat	6	100.0	0	0.0	3	42.9	**0.001***
Weight							
- Normal	0	0.0	7	100.0	7	100.0	**20.00**
- Underweight	6	100.0	0	0.0	0	0.0	**0.000***
Pancytopenia							
- present	4	66.7	1	14.3	2	28.6	**7.921**
- Not present	2	33.3	6	85.7	5	71.5	**0.001***

* Significant at level P<0.05

Table (7): Percentage distribution of children related to signs of rejection for Graft Versus Host Diseases.

Signs of rejection and GVHD	Studied children(n=20)						
	Before EBP guidelines implementation (n=6)		Immediately after EBP guidelines implementation (n=7)		After one month from EBP guidelines implementation (n=7)		χ^2 P
	No	%	No	%	No	%	
Skin GVHD							
Dry rashed skin							
- Not present	0	0.0	5	71.4	5	71.4	**24.81**
- present	6	100.00	2	28.6	2	28.6	**0.001***
Mouth and GIT GVHD							
Bleeding ,ulcer & sores of gum							
- Not present	0	0.0	5	71.4	4	57.1	**7.302**
- Present	6	100.0	2	28.6	3	42.9	**0.026***
Oral mucositis							
- No	0	0.0	5	71.4	4	57.1	**7.302**
- Yes	6	100.0	2	28.6	3	42.9	**0.026***
Diarrhea							
- Not present	0	0.0	7	100.0	4	57.1	**13.074**
- present	6	100.0	0	0.0	3	42.9	**0.001***

* Significant at level P<0.05.

Table (8): Percentage distribution of children related to their signs of infection.

Signs of infection	Studied children(n=20)						
	Before EBP guidelines implementation (n=6)		Immediately after EBP guidelines implementation (n=7)		After one month from EBP guidelines implementation (n=7)		χ^2 P
	No	%	No	%	No	%	
Hyperthermia							
- Present	6	100.0	0	0.0	1	14.3	**16.232**
- Not present	0	0.0	7	100.0	6	85.7	**0.000***
Hotness at site of Hickman							
- Present	6	100.0	1	14.3	3	42.9	**9.714**
- Not present	0	0.0	6	85.7	4	57.1	**0.008***
Redness &Swelling around site of Hickman							
- Present	6	100.0	1	14.3	3	42.9	**9.714**
- Not present	0	0.0	6	85.7	4	57.1	**0.008***

* Significant at level P<0.05

Table (9): Correlation between total knowledge and total practice scores of studied nurses' before, immediately and after one month from Evidence Based Nursing Guidelines' implementation

Total Practice Score	Total knowledge score					
	Before EBP guidelines		Immediately after EBP guidelines		After one month	
	r	P	r	P	r	P
	0.407	**0.026***	**0.201**	**0.001***	**0.137**	**0.013***

r: Pearson' correlation coefficient

* Significant at level P<0.05

Discussion

Stem cell transplantation is a medical treatment in which functional and healthy stem cells are used to replace the diseased bone marrow of those with malignant and non-malignant disorders.[32] The nurses are committed to improve their quality of life and ensuring that they have the greatest possible level of physical and mental comfort .[14]

Nurses in stem cells transplantation units are critical and vital members in the management and prevention of the early and late complications of HSCT process. They require specific training and should use Evidence Based Nursing Guidelines that provide them with the scientific research to make well-founded decisions about health

care of the child and reduce their expected complications.[14]

Regarding educational level of nurses, the result showed that nearly two thirds of nurses had bachelor degree**.** It may due to that the administrators of the unit were selecting them for the unit of BMT due to their abilities to understand the tasks more efficiently. **Ali et al., (2019)** was agreed with current finding who reported that majority of nurses were bachelor degree. [33] While these results disagreed with **Mary (2016)** who clarified that the majority of nurses had nursing diploma. [34]

Regarding nurses' years of experience**,** the results of the current study clarified that most of studied nurses had less than five years of experience in the bone marrow transplantation unit. This might be related to the modernity of the BMT medical field in Egypt and this BMT unit is newly established in Tanta Universal Teaching Hospital. **Ali et al., (2019**) was in harmony with the current finding who reported that more than half of the studied nurses had years of experience from one to less than five years. [33] While **Khalil (2016)** disagreed with these results who reported that less than two-third of nurses had an experience of more than 10 years. [35]

As regards nurses' attendance of training courses related to bone marrow transplantation, the current study revealed that most of them didn't attend training programs related to bone marrow transplantation. It may be due to the shortage in nurses' number in BMT unit and work over load that prevent them from attendance any training programs .This findings correspondent to **Shaban (2018)** who found that the majority of the nurses hadn't any previous information. [36] Similarity **Rochester (2017)** who reported that nurses working in the bone marrow transplantation unit needs extra education to give optimal care for patients. [37]

In relation to residence of the studied children, the study showed that the most of studied children were from rural areas **.**It might due to that the surrounding areas around Tanta universal Teaching Hospital are rural areas. This study supported by **Bhatt et al.,(2014)** whose results revealed that the most of children were living in rural areas.[38]

Regarding medical history of the studied children**,** the current study revealed that three quarters of total studied children were diagnosed as thalassemia and it was noticed that all of them had received previous blood contents**.** It might be due to the indication of Bone Marrow Transplantation which depends on various factors as type and stage of disease, response to previous treatment as BMT is a life- saving procedure for many diseases such as aplastic anemia, leukemia, inherited blood diseases as thalassemia, sickle cell disease and autoimmune diseases.

Elhaddad (2017) and **Sherif (2016)** were in harmony with the current finding as they clarified that most of children undergoing bone marrow transplantation had cancer and blood diseases as thalassemia, aplastic anemia and all of them need continuous blood content transfusion and chemotherapy related to their diseases. [6,39]

Regarding total scores of nurses' knowledge regarding stem cell transplantation, the results of current study revealed that all of them had low level of knowledge about stem cell transplantation before EBNGs implementation while immediately after guidelines' implementation, nurses' knowledge improved and all of them had good knowledge scores whereas one month after EBNGs implementation, there was a

slight decline in nurses' total knowledge scores.

Khalil et al., (2021) were in the same line with the current study who reported that less than one fifth of nurses had good level of knowledge about bone marrow transplantation before EBNGs implementation while immediately after guidelines' implementation, three quarter of them had good level of knowledge but after three months follow up, there was a slight decline in nurses total knowledge. (40)

Also **Karaly et al., (2019)** who agreed with the current study that all of the study nurses had an unsatisfactory total knowledge score before educational guidelines application while their total knowledge score improved to satisfactory score after guidelines application, while this improvement lowered slightly in the follow up phase.(41)

Regarding total nurses' practices scores for children undergoing stem cells transplantation, the current study clarified that nearly all of the studied nurses had unsatisfactory level of practice regarding care of children before implementation of EBNGs **.**While immediately after implementation, all of them had satisfactory level of practice. But there was a slight decline in nurses' practice after one month from EBNGs implementation**.**

El- Sayed et al., (2020) who mentioned that a majority of studied nurses had incompetent level of performance pre application of clinical nursing protocol in regard to care of children with stem cell transplantation therapy contrasted with more than two third of them had competent level of performance after protocol intervention, and declined to more than half of them at follow up protocol intervention phase. (42)

Regarding to complications and clinical outcome of the studied children, the current study showed that all of studied children suffered from some early and late complications as low cell count, oral mucositis, decrease in body weight, infection signs and GVHD before implementation of evidence based guidelines **.**While this complication decreased immediately and one month after guidelines' implementation.

This result in accordance with **Sherif (2016)** who revealed that there was significant improvement in studied patient's complications after implementation of educational program. (39)Also **Singh (2015)** who stated that promoting nurses' knowledge will decrease complications of their patients. (43)

As regard correlation between total nurses' knowledge and practices regarding children undergoing stem cell transplantation the current finding represent that, there was statistically significant positive correlation between total knowledge scores and total practice scores before, immediately and one month after guidelines' implementation.

Also **Ali et al., (2019)** was in the same harmony with this result who reported that there was a positive correlation between total knowledge score and total practice score pre and post teaching program. (33)

Conclusion

Based on the results of this study, it can be concluded that, nurses' knowledge and practices regarding care for children undergoing bone marrow transplantation were significantly improved after EBNGs implementation and there was statistically significant improvement in the children's outcomes with statistically significant decrease in their complications immediately after guidelines' implementation.

Recommendations

-In-service training programs should be conducted periodically and regularly for all

nurses working in bone marrow transplantation unit about application of evidence-based nursing guidelines for children undergoing bone marrow transplantation.

-Bone marrow transplant units must have a documented policy describing the standard nursing care that should each patient receives in the unit.

-Developing a system at bone marrow transplantation unit for evaluating nurses' knowledge and practice regarding the updated strategies in care of children undergoing bone marrow transplantation.

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