

Effect of Implementing an Educational Program on Knowledge and Performance of Nurses Caring for Patients with Stem Cell Transplantation



Eman Fathy Mohamed Ali 1 , Dr. Karima Fouad El shamy 2, Dr. Madiha Hassan Nabih 3 ,
Dr. Mohamed Nasr Mabed 4

1B.S.c-Nursing, Clinical Instructor – Mansoura Specialist Hospital

2Professor of Medical Surgical Nursing, Faculty of Nursing, Mansoura University, Egypt

3Assist Professor of Medical Surgical Nursing, Faculty of Nursing, Mansoura University, Egypt

4Professor of Hematology and Bone Marrow Transplantation, Faculty of Medicine Mansoura University, Egypt

E-mail address: noreldinmohamed310@gmail.com

1.ABSTRACT

Background: Hematopoietic stem cell transplantation (HCT) is the curative treatment of choice for many malignant and nonmalignant hematologic disorders, nurses play a crucial role in patients' care. So, they must be knowledgeable and aware of recent trends in diagnosis and treatment, competent and able to apply their knowledge of nursing into practice. **Aim:** evaluate the effect of an educational program on knowledge, and performance of nurses caring for patients undergoing stem cell transplantation. **Sample:** Convenient sample of all available nurses (30 nurses) in stem cell transplantation unite, Oncology Center, affiliated to Mansoura University Hospitals. **Methodology:** Quasi-experimental design was used. **Tools:** Two tools were used Structured interviewing questionnaire, and performance chick list. **Results:** that most of the studied nurses (80%) had poor knowledge level before application of educational program after application of educational intervention most of the studied nurses (83.7%) become knowledgeable about stem cell transplantation. Also, performance level of the studied nurses about stem cell transplantation reach 90% after application of educational program. **Conclusion:** there were highly significant development in nurses' knowledge and performance after application of educational program about stem cell transplantation. **Recommendations:** continuous nursing education and training programs should be implemented regularly in stem cell transplantation unit.

Keywords: Educational Program, Knowledge, Performance, Nurses, Stem Cell, Transplantation.

2.Introduction:

Recently, the most effective and curative therapy for life-threatening blood disorders and bone marrow dysfunction is using hematopoietic stem cell transplant (HSCT). Such of the hematological disorders could be cured with HSCT are; lymphomas, leukemia, acquired aplastic anemia, sickle cell disease and thalassemia (Caocci et al., 2017). Since, hematopoietic stem cells function as a lifelong source of blood cells and have the ability to differentiate and synthesizing mature blood cells. Numerous research studies and clinical trials are still performing to evaluate the efficacy of HSCT in different therapeutic conditions (Hazzazi et al., 2019).

Furthermore, nurses have an important role in imparting knowledge, therefore, the nursing education should include the current technologies to update the knowledge regarding recent advances. Structured teaching program is one of the effective and beneficial method that involve multi-dimensional teaching strategies to acquire and impart knowledge (Mohammed and El Sayed,

2015). In addition, nurses must play a crucial role in patients' education about stem cell therapy in various health care settings. So, they must be knowledgeable and aware of recent trends in diagnosis and treatment, competent and able to apply their knowledge into practice (EdwinFrancis et al., 2016).

Significance of the study

Stem cells researches related to hematopoietic stem cells are increasing worldwide with promises to human health. This scientific innovation requires nurses to prepare themselves with knowledge gained from specialized nursing research and their own ethical decision (Azzazy and Mohamed, 2016).

Health care providers are great sources of information, but they sometimes can inadvertently provide misinformation. This has definitely created a challenge to staff HCT programs with the needed number of adequately trained health care personnel (Peberdy et al., 2016) (Kharfan-Dabaja and Aljurf, 2017).

Aim of the study

To evaluate the effect of an educational program on knowledge, and performance of nurses caring for patients undergoing stem cell transplantation.

Research hypothesis

Knowledge and performance of nurses caring for patients undergoing stem cells therapy will be improved after implementing an educational program regarding stem cell transplantation.

3.Methodology

Research Design:

Quasi-experimental study design was utilized to carry out this study.

Setting:

This study was accomplished in inpatient and outpatient clinic in Specialized Medical Hospital at Mansoura University.

Participants:

A convenient sample of all available nurses (30 nurse) providing care for patients undergoing stem cell transplantation.

Tools:

Two tools were used to collect the data for this study.

Tool: Nurse's knowledge Assessment Questionnaire

This tool was developed based on review of relevant recent literature (*Ikuta, 2008*, *Cooper & Severson., 2013*). to assess demographic characteristics and level of knowledge of the studied nurses regarding stem cell transplantation and consists of two parts:

Part 1: This part will be used to address the personal data of the studied nurses which includes; nurses' age, sex, educational level, years of experience in stem cell transplantation unite, and attendance of workshops or conference related to stem cell transplantation therapy.

Part 2: Nurses' Knowledge Assessment: To assess nurses 'knowledge before, and after implementation of the designed teaching program regarding stem cell transplantation and includes 8 parts (37 question) which includes:

Part I: Anatomy and source of stem cell (4 questions)

Part II: Proprieties of stem cell (2 questions)

Part III: Types of stem cells (7 questions)

Part IV: How to collect and preserve stem cell (4 questions)

Part V: knowledge about stem cell transplantation and its complications (7 questions)

Part VI: Ethical issues of stem cell transplantation (2 questions)

Part VII: steps of stem cells transplantation (5 questions)

Part VIII: health education for patient after stem cells transplantation (6 questions)

Scoring system of nurses' knowledge: Two level of scoring for questions were used as the following: multiple choice question were developed by researcher. Each item was given a score (1) for correct answer, and (0) wrong answer. To better present knowledge, scores were presented as:

Poor < 50% of total score (<18.5).

Fair = 50 % to 75% of total score (18.5-27.75)

Good > 75 % (> 27.75)

Tool II: - performance Checklist

This tool were developed by the researcher after review recent related literature (*Cooper & Severson.,2013, Ikuta., 2008*). to assess nurses' performance regarding stem cell transplantation before and after the implementation of the designed teaching program regarding stem cell transplantation which includes:

1. Nurses' performance regarding management of patients before stem cell transplantation, which includes (13) steps.
2. Nurses' performance during and after stem cell transplantation, which includes (12) steps.
3. Nurses' performance regarding patient discharges from the stem cell transplant unit, which includes (11) steps.

Scoring system: Each item was checked as done correctly, done incorrectly or not done. The items observed as "done correctly" was given score "2" and the " done incorrectly" was given a score "1"and the "not done" was given a score "0" then the scores of the items will be summed-up and the total divided by the number of items and converted into percent scores. The nurses' practice will be considered "satisfactory" if the percent score is 75% or more and "unsatisfactory" if less than 75%.

Content validity:

A panel of five experts *validated* the tools' content by reviewing the clarity, comprehensiveness, relevance, applicability, understanding, and ease of execution, and slight adjustments were made.

Tool reliability:

Reliability was used to evaluate the internal consistency of the tool using Cronbach's alpha = 0.903 For performance questionnaire: Cronbach's alpha = 0.855. This means that the reliability of the tools is very good.

Pilot study:

A pilot study was conducted on 10% (3 nurses) of study sample to test feasibility, objectivity, clarity and the applicability of the study tools.

Methods

Data collection process:

-Administrative phase: Written approval to conduct the study were obtained from responsible authorities of Oncology Center affiliated from Mansoura University Hospital, Egypt after explanation of the aim of the study.

-Intervention: data collection tool was developed by the researcher based on reviewing recent relevant literature.

-The developed tools were tested for content related validity by jury of 5 Experts in the field, the tools were tested for content validity and the necessary modification were done.

-The reliability for the study tools was calculated by Cronbach's coefficient alpha.

-A Permission for voluntary participation were obtained from nurses after clear explanation of the nature and purpose of the study.

Operational phase: was conducted on four phases as follows:

I-Assessment phase: This phase aimed to collect data from nurses under the study to identify demographic data by using tool (1) part I, nurses knowledge using tool 1 part II and nurses performance using tool (2)

This phase includes:

- Interviewing the nurses to collect baseline data
- Explaining the purpose, duration, and activities of the study and taken written consent.
- Pre-test was done to assess nurses' knowledge and skills regarding stem cells therapy.
- The data obtained during this phase constituted the base line for further comparison to evaluate the effect of an educational intervention.
- Average time for the completion of each nurse interview was around (20-30 minutes).

II - Planning phase: Based on baseline data obtained from pre-test assessment and review of relevant literature, the instructional content, expected outcome and media in the form of (booklet and visual materials) were prepared by the researcher in simple Arabic form based on review of recent literature to satisfy the studied nurses' deficit knowledge, and skills regarding stem cells transplantation therapy.

III - Implementation phase:

-Educational intervention was implemented for studied nurses in the above mentioned setting by visiting the previously mentioned setting in the the morning and afternoon three days/week alternatively.

-Every session was taken 30 – 45 min.

-Pretest assessment performed at the beginning of the study and consider as base line data for latter comparison with future posttest.

-The general and specific objectives were achieved through several teaching methods such as brain storming, discussion, hand out, and the used illustrated media (video, pictures and PowerPoint presentation), at the end of each session, time was allowed for asking and giving feed back

-The educational intervention involved (4) scheduled sessions and will be implemented according to working circumstances, nurses' physical and mental readiness.

-These sessions were repeated to each subgroup of (3-5) nurses.

-Arabic language was used to suit the nurses' level of understanding.

-Feedback was given in the beginning of each session about the previous one.

-Suitable teaching media were included, and an educational booklet will be distributed to all nurses in the first day of the educational intervention.

IV - Evaluation phase:

-Posttest assessment were carried out after implementation of the teaching program to identify its effect on nurse's knowledge and performance.

-Assessment of nurse's performance were performed by observing the nurses' performance using performance checklist before and immediately after implementation of educational program. The researcher completes the checklist while the nurses

demonstrate nursing procedure related to stem cell transplantation therapy.

Ethical Considerations and Human Rights:

The Research Scientific Ethical Committee of Mansoura University's Faculty of Nursing provided ethical permission. Following an explanation of the study's goal, an official written authorization to carry out the study was acquired from the director of Oncology center affiliated to Mansoura University.

Statistical analysis:

An appropriate statistical method and tests were used for analysis of data by using SPSS, all data were Collected data were coded, computed and statistically analyzed using SPSS (statistical package of social sciences), version 22. Data were presented as frequency and percentages (qualitative variables) and mean ± SD (quantitative continuous variables). Chi square (χ²) was used for comparison of categorical variables, and was replaced by Fisher exact test (FET) or Mont Carlo Exact test if the expected value of any cell was less than 5. Paired t test was used for comparison of continuous quantitative variables (two groups). For continuous quantitative variables which were not normally distributed, Median was used as a central tendency measures and Wilcoxon Signed Ranks test (Z) was used for comparison of two groups. The difference was considered significant at P ≤ 0.05.

4.Results

Table (1): shows the characteristics of the studied nurses. Out of 30 nurses; 70.0% were females and mostly (56.7%) aged 20 – 30 years. As regard their jobs. More than half (56.7%) certified from nursing technical institute and the rest of them 43.3 had bachelor degree of nursing. The majority of the studied nurses (70%) had years of experience for more than three years. In relation to attendance of workshops about stem cell transplantation 53.3% did not participated in any training programs,

40.0% participated in only one training session while 6.7% participated in 2-3 sessions.

Table (2):Representing comparison of mean knowledge score of the studied nurses about stem cell transplantation before and after educational intervention. It is clear that mean knowledge score of the studied nurses increased after application of educational intervention in all domains, with increased total mean knowledge score post educational intervention (34.53 ± 2.76) compared to pre educational intervention (11.00 ± 7.32), representing statistical significant difference (t=19.138, P<0.001)

Figure (1): illustrates that, most of the studied nurses (80%) had poor knowledge level before educational intervention, after application of educational intervention most of the studied nurses (83.7%) become knowledgeable about stem cell transplantation.

Table (3): shows the performance average score before and after intervention among the studied nurses. There are highly statistical significant (P<0.001) increase in the mean score of different performance domains after application of educational intervention, showing statistical significant difference (P<0.001).

Figure (2): This figure shows that performance level improved after implementing educational intervention and show that level of satisfaction before educational intervention was 70.0% and improved to 90% post educational intervention.

Figure (3 and 4): Show the correlation between nurses' total knowledge score and total practice score before and after educational intervention, there is negligible correlation (r = 0.045, P0.814) between nurses' total knowledge score and total practice score before educational intervention, whereas after educational intervention a significant, mild, positive correlation (r = 0.352, P0.049) appears between nurses' total knowledge score and total practice score.

Table (1): Demographic Characteristics of the studied nurses (n=30)

| Characteristics | Items | No | % |
|-----------------------------------|-----------------------------|----|------|
| Sex | Female | 21 | 70.0 |
| | Male | 9 | 30.0 |
| Age | 20-30 | 17 | 56.7 |
| | 31-40 | 10 | 33.3 |
| | 41+ | 3 | 10.0 |
| Educational level | Nursing technical institute | 17 | 56.7 |
| | Bachelor of nursing | 13 | 43.3 |
| Years of experience | Less than one year | 9 | 30.0 |
| | 1-3 years | 0 | 0.0 |
| | More than three years | 21 | 70.0 |
| Attendance of workshops about SCT | No | 16 | 53.3 |
| | One session | 12 | 40.0 |
| | 2-3 sessions | 2 | 6.7 |

SCT: stem cell transplantation

Table (2): Comparison between mean knowledge score of the studied nurses regarding stem cell transplantation before and after educational intervention

| Knowledge Domains | Before Intervention | After Intervention | Significance test |
|----------------------------------------------------------------------|---------------------|--------------------|---------------------|
| | Mean ± SD | | |
| 1. Knowledge about anatomy and sources of stem cells | 1.23 ± 1.19 | 3.67 ± 0.54 | t=10.656 P<0.001 |
| 2. Knowledge about prosperities of stem cells | 0.43 ± 0.73 | 1.87 ± 0.34 | t=10.785 P<0.001 |
| 3. Knowledge about types of stem cell | 1.43 ± 1.35 | 6.67 ± 0.55 | t=25.956 P<0.001 |
| 4. Knowledge about how to collect and preserve stem cells | 1.37 ± 1.24 | 3.80 ± 0.41 | t=11.439 P<0.001 |
| 5. Knowledge about complications of stem cells transplantation | 0.17 ± 0.38 | 0.97 ± 0.18 | t=10.770 P<0.001 |
| 6. Knowledge about ethical issue of stem cells transplantation | 0.30 ± 0.59 | 1.57 ± 0.50 | t=11.894 P<0.001 |
| 7. Knowledge about steps of stem cells transplantation | 1.70 ± 1.39 | 4.53 ± 0.68 | t=11.799 P<0.001 |
| 8. Knowledge about Health Education after stem cells transplantation | 4.37 ± 3.26 | 11.47 ± 1.11 | t=14.359 P<0.001 |
| Total Knowledge Score | 11.00 ± 7.32 | 34.53 ± 2.76 | t=19.138 P<0.001 |

T test is value of paired t test

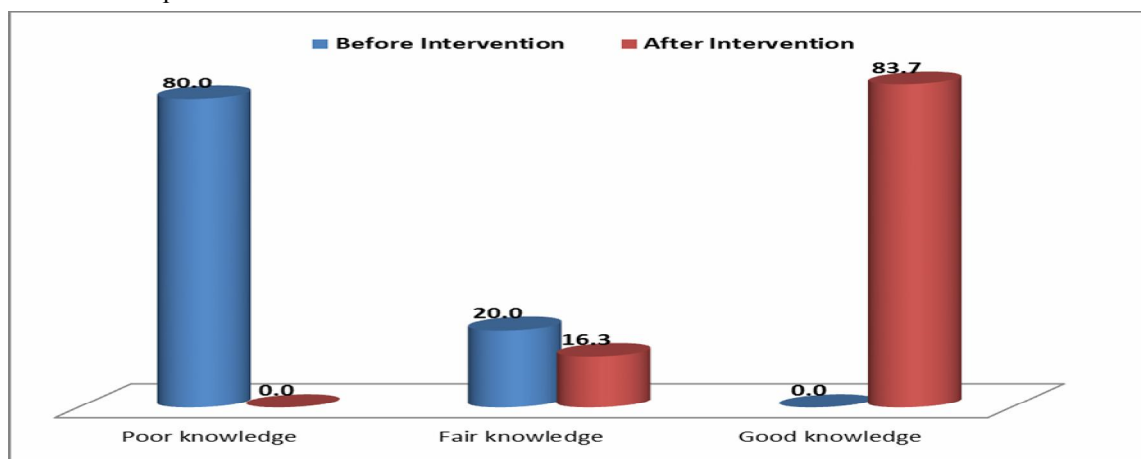


Figure1-Knowledge level of the studied nurses about stem cell transplantation before and after educational intervention.

Table (3): Performance average score

| Items | Before Intervention | | After Intervention | | Sign. test |
|------------------------------------------------------------------------------------------------------------|---------------------|------|--------------------|------|-------------------------|
| | Mean | ±SD | Mean | ±SD | |
| Nurses' performance regarding management of patients' before stem cell transplantation | 18.00 | 1.31 | 20.00 | 0.00 | t=8.343.00, P <0.001 |
| Nurses' performance regarding management of patients' after stem cell transplantation | 21.90 | 1.42 | 24.00 | 0.00 | t=8.085.00, P <0.001 |
| Nurses' performance regarding management of patients during discharge from stem cell transplantation unit. | 18.60 | 4.52 | 22.00 | 0.00 | t=4.125.00, P <0.001 |
| Total Score Pre | 58.93 | 4.86 | 66 | 0.00 | t=7.959, P <0.001 |

Mean± Standard deviation, Independent t-test ** Significant difference at p. value<0.001

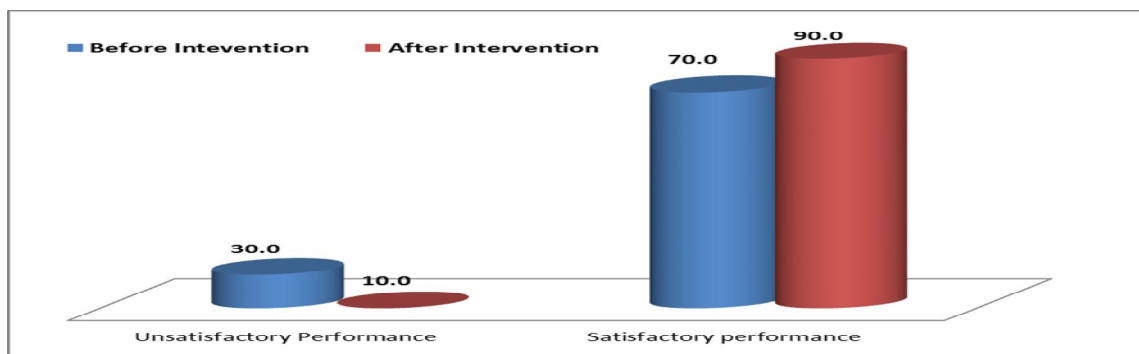


Figure (2): Performance level of the studied nurses about stem cell transplantation before and after intervention

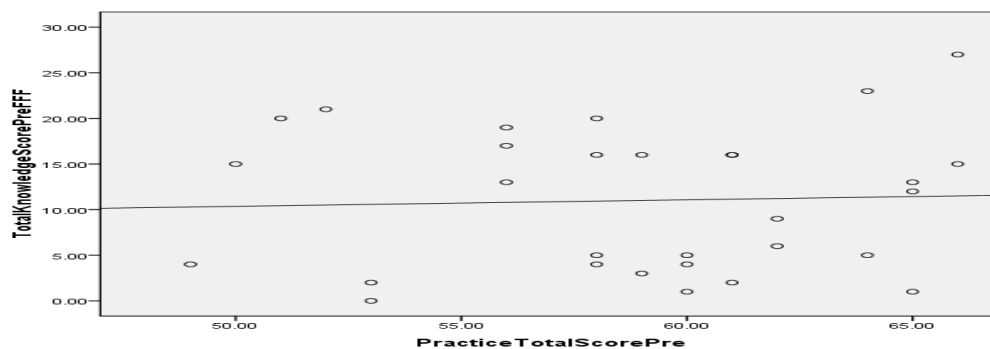


Figure (3): Correlation between total knowledge score and total practice score before intervention among the studied nurses

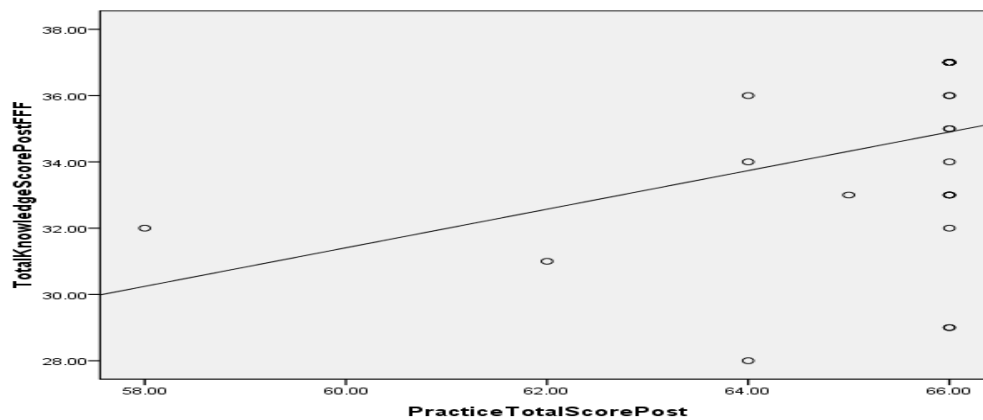


Figure (4): Correlation between total knowledge score and total practice score after intervention among the studied nurses

5. Discussion

Hematopoietic stem cell transplantation (HSCS) is a treatment modality for hematological, oncological, hereditary and immunological diseases, which consists of the intravenous infusion of hematopoietic stem cells to reestablish the patients medullary and immune function (*Campos de Azevedo et al., 2018*). The nurses are dedicated for promoting quality of life and providing an optimal physical and emotional comfort (*Schuster, 2021*). Therefore, this study was conducted to

evaluate the effect of implementing an educational program on Knowledge, and performance of nurses caring for patients with stem cell transplantation.

The study result revealed that more than half of the nurses were in the age group (20 -30) years old. It may be due to the unit was recently established and the administrators selected young age nurses to be able to perform these specific nursing care in the unit effectively.

This result was in agreement with *Mohammed and El Sayed (2015)* who reported in

their study nurses 'knowledge regarding stem cells therapy that more than half of nurses were aged from (20-25) years old. Also, the same findings were reported by *Mansour et al.* who mentioned that the majority of his studied nurses age ranged from 20-35.

Regarding to educational level, the result showed that majority of nurses were nursing technician, this result in disagreement with *Mohammed and El Sayed (2015)* who reported that the majority of nurses who are working in SCT unit had diploma degree in nursing.

In relation to training workshop the present study revealed that the majority our studied nurses didn't attend any training workshops, and the majority of those attending training workshops participated in only one training session. This result was in agreement with *Rochester (2017)* who said that nurses who are working in the bone marrow transplantation unit needs additional education to provide optimal care for patients that are including; preparatory regimens, intensive supportive therapies for patients, stem cell and marrow infusions.

On assessing knowledge of the studied nurses regarding stem cell transplantation, the findings of the current study revealed that, before educational intervention the majority of the studied nurses had poor knowledge regarding stem cell transplantation. After application of educational intervention; the level of knowledge completely changed as the majority of them become fully knowledgeable about stem cell transplantation. their low scores of knowledge may be attributed to the fact that stem cell transplantation therapy are new advanced trend and the nursing school's curriculum, especially the secondary level schools are still deficient in this issue. As well as after graduation, nurses neglect reading updating their professional knowledge besides lack of motivation.

This result was in agreement with *Khalil and Mohammed Khali and El Sayed Sharshor (2016)*. they assessed the nurses' knowledge about stem cells in Tanta, Egypt, they reported that nurses' knowledge about stem cells is inadequate in the majority of participants, so they need educational program to improve it. In addition to *Leng et al. (2016)*. mentioned that nurses 'knowledge toward bone marrow and stem cells is moderate and they recommended the need for in-service educational programs related to bone marrow and stem cells transplantation to develop nurses 'knowledge and practice in order to fit this contemporary trend in health care.

On the other hand, this result was agreed with *El-Sayed et al. (2018)* who presented that about three-quarters of the participants had adequate knowledge after receiving an educational program and there was a significant difference between the level of knowledge in the pre and post educational intervention. According to *Fernandes et al. (2019)* they mentioned that nurses must be educated about management and specific needs of stem cell transplantation patients and their families to improve their knowledge regarding transplantation surgery, its progress and expected complications. *Khalil and Sharshor (2016)* emphasized that increased level of awareness among the healthcare providers, can work positively towards improving stem cell transplantation patients' care.

Performance assessment of the studied nurses:

Regarding to nurses' practice about management of patients' pre, during and after stem cell transplantation. The results revealed that there were highly significant improvements in the nurses' performance regarding management of patients undergoing stem cell transplantation after application of educational program. The lack of nurses' practice regarding bone marrow and stem cells transplantation may be due to late exposure to stem cell technology in the clinical area as stem cell transplantation unit Oncology Center Mansoura University Hospital is newly constructed unite. Moreover, the nurses lack the efficiency of updating their practice after being settled in the clinical environment for a longer time.

In the same line with our results *Neumann (2017)* revealed that nurses play a key role in assessing, monitoring and supporting patients. So it is strongly recommended that, nurses should be trained to prevent and manage early and late complications arising from hematopoietic stem cell transplantation, such as transfusion reactions, safe medication administration, infection prevention, central venous catheter management, patient and family education, and complications of the conditioning regimen.

Faulkner et al. (2021) emphasized that nurses must be educated about the necessary pre-transplant tests to be done, answer any questions or concerns that the patients or their family may have and manage the care of the donor during marrow transplantation. In addition *Ferreira et al. (2017)* mentioned that nursing care for patients undergoing hematopoietic stem cell transplantation is complex and requires a high level of competence. The nurse care provided throughout the procedure strongly influences the success of the transplantation. The

nurse is responsible for customizing this care task in all stages of the transplantation. educational interventions are considered most effective for stem cell transplantation nurses to help increasing their practice.

Metoyer (2013) emphasized that considering these caregivers participate in the care offered to the stem cell transplantation patients, it is imperative that they receive different guidelines. In this sense, in order to enable them to acquire knowledge and skills, it is fundamental that the health team, initially, identify their learning needs and promote teaching strategies, regarding the performance of their role, since infections related to health care should not be a concern only of patients and health professionals.

Also the study result revealed that there was statistical significant positive correlation among nurses' knowledge and their practice level. This result was in congruence with the study carried out by *Ali (2019)* titled effect of teaching program on nurses' knowledge and performance regarding patients undergoing bone marrow transplantation in Assiut university, They reported that there were a highly positive correlation between nurses' knowledge and their practice as their practice regarding management of patients undergoing bone marrow transplantation improved after application of educational intervention.

6. Conclusion

There was a significant improvement in the total knowledge score among the studied nurses after application of educational intervention. Highly positive correlation between nurses' knowledge and their practice was documented as their practice regarding management of patients undergoing stem cell transplantation improved after application of educational intervention.

7. Recommendations

- Continuous in-service training programs stem cell transplantation therapy to develop nurses' knowledge and performance in order to fit newly concepts and technological advancement in care.
- Integrate stem cell transplantation therapy as a new technological advancement in the nursing curriculums.
- Stem cell transplantation therapy guidelines should be accessible to all nursing staff to guide their performance based on slandered care.

8. Acknowledgments

The authors would like to offer their appreciation and gratitude to all nurses who participated in the study willingly..

9. References

- Ali, A. 2019. Effect of Teaching Program on Nurs's Performance Regarding Bone Marrow Transplantation. *Assiut Scientific Nursing Journal*, 7: (18), 12-21.
- Azzazy, H. M. & Mohamed, H. F. 2016. Effect of educational intervention on knowledge and attitude of nursing students regarding stem cells therapy. *IOSR Journal of Nursing and Health Science*, 5: (2), 75-80.
- Campos de Azevedo, I., Ferreira Júnior, M. A., Pereira de Aquino, L. A., de Oliveira, A. A., Cruz, G. K. P., de Queiroz Cardoso, A. I., et al. 2018. Epidemiologic Profile of Patients Transplanted With Hematopoietic Stem Cells in a Reference Service in the State of Rio Grande do Norte, Brazil. *Transplantation Proceedings*, 50: (3), 819-823.
- Caocci, G., Orofino, M. G., Vacca, A., Piroddi, A., Piras, E., Addari, M. C., et al. 2017. Long-term survival of beta thalassemia major patients treated with hematopoietic stem cell transplantation compared with survival with conventional treatment. *American Journal of Hematology*, 92: (12), 1303-1310.
- Edwin Francis, C., Deenajothy, R. & Immanuel, M. 2016. Effectiveness of structured teaching programme on knowledge regarding stem cells and cord blood banking among antenatal mothers at Mogappair, Chennai. *International Journal of Pharmacy and Biological Sciences*, 6: (1), 135-141.
- El-Sayed, H., Elmashad, H. & Aboud, S. 2018. Application of Counseling about Umbilical Cord Stem Cell Collection and Banking among Pregnant Women: Its Effect on Their Knowledge and Attitude. *American Journal of Nursing Research*, 6: (5), 214-221.
- Faulkner, L., Verna, M., Rovelli, A., Agarwal, R. K., Dhanya, R., Parmar, L., et al. 2021. Setting up and sustaining blood and marrow transplant services for children in middle-income economies: an experience-driven position paper on behalf of the EBMT PDWP. *Bone Marrow Transplantation*, 56: (3), 536-543.
- Fernandes, D. R., Braga, F. T. M. M., Silveira, R. C. d. C. P. & Garbin, L. M. 2019. Hand hygiene: knowledge and skill of caregivers in

- the hematopoietic stem cell transplantation. *Revista Brasileira de Enfermagem*, 72: (6), 1653-1662.
- Ferreira, M., Nascimento, L. C., Braga, F. T. M. M. & Silva-Rodrigues, F. M. 2017. Competências de enfermeiros nos cuidados críticos de crianças submetidas a transplante de células-tronco hematopoéticas. *Revista Eletrônica de Enfermagem*, 19.
- Hazzazi, A. A., Ageeli, M. H., Alfaqih, A. M., Zakri, A. K. & Elmakki, E. E. 2019. Knowledge and attitude towards hematopoietic stem cell transplantation among medical students at Jazan University, Saudi Arabia. *Saudi Medical Journal*, 40: (10), 1045-1051.
- Ikuta, L. M. 2008. Human Umbilical Cord Blood Transplantation. *AACN Advanced Critical Care*, 19: (3), 264-267.
- Khalil, A. M. & Sharshor, S. M. 2016. Pediatric Nurses Knowledge, Awareness and Attitude towards Application of Stem Cells Therapy in Children. *IOSR Journal of Nursing and Health Science*, 5: (4), 88-96.
- Kharfan-Dabaja, M. A. & Aljurf, M. 2017. Hematopoietic cell transplantation: Training challenges and potential opportunities through networking and integration of modern technologies to the practice setting. *Hematology/Oncology and Stem Cell Therapy*, 10: (4), 184-188.
- Leng, L. J., Keng, S. L., WanAhmad, W. A. N. & Cheng, T. S. 2016. ASSOCIATION BETWEEN NURSES' KNOWLEDGE AND ATTITUDES TOWARD STEM CELL APPLICATION IN MEDICINE. *The Malaysian Journal of Nursing (MJN)*, 7: (3), 3-9.
- Mansour, S. E.-S., Gouda, A. M. I. & Ibrahim, A. A.-W. Effect of an Educational Program on Nurses' Knowledge and Attitudes Regarding Umbilical Cord-blood Stem Cells Preservation.
- Metoyer, D. N. P. F. N. P. L. J. 2013. Education of Hematopoietic Stem Cell Transplant Caregivers in Preparation for Their Role. *Journal of the Advanced Practitioner in Oncology*, 4: (6).
- Mohammed, H. S. & El Sayed, H. A. 2015. Knowledge and attitude of maternity nurses regarding cord blood collection and stem cells: An educational intervention. *Journal of Nursing Education and Practice*, 5: (4).
- Mohammed Khali, A. M. S. & El Sayed Sharshor, S. M. 2016. Pediatric Nurses Knowledge, Awareness and Attitude towards Application of Stem Cells Therapy in Children. *IOSR Journal of Nursing and Health Science*, 05: (04), 88-96.
- Neumann, J. 2017. Nursing challenges caring for bone marrow transplantation patients with graft versus host disease. *Hematology/Oncology and Stem Cell Therapy*, 10: (4), 192-194.
- Peberdy, L., Young, J. & Kearney, L. 2016. Health care professionals' knowledge, attitudes and practices relating to umbilical cord blood banking and donation: an integrative review. *BMC Pregnancy and Childbirth*, 16: (1).
- Rochester, U. 2017. Bone Marrow Transplant/Hematology—EI 94. *Mayo clinic, Eisenberg*, 94.
- Schuster, M. A. 2021. Creating the Hematology/Oncology/Stem Cell Transplant Advancing Resiliency Team: A Nurse-Led Support Program for Hematology/Oncology/Stem Cell Transplant Staff. *Journal of Pediatric Oncology Nursing*, 38: (5), 331-341.
- Whnp, M. R. S. M. S. N. R. N. 2013. Cord blood and tissue banking: supporting expectant parent's decision making. *International Journal of Childbirth Education*, 28: (2), 62.