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(RESEARCH ARTICLE)

An Evaluative Study to determine the Effectiveness of Multimodal Teaching Program on Bone Marrow Transplantation upon learning outcome among Staff Nurses at selected Hospitals, Chennai

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Abstract

Background: A bone marrow transplant replaces diseased or damaged bone marrow with healthy hematopoietic stem cells, often after chemotherapy or radiation. In cancer treatment, donor white blood cells can also help eliminate residual cancer cells through an immune-mediated effect.

Advances in transplantation have improved survival rates and life expectancy among patients. However, survival outcomes continue to vary depending on multiple factors.

Nurses play a crucial role in providing direct care to both adult and pediatric patients throughout the transplant process. Continuous education and regular training are essential to ensure nurses remain updated on current scientific practices and guidelines. Strengthening nurses' knowledge and skills helps reduce post-transplant complications and improve patient outcomes.

Materials and Methods: A true experimental study was conducted at Apollo Cancer Centre, Chennai, with 60 registered nurses to assess the Effectiveness of a Multimodal Teaching Program on Bone Marrow transplantation. Structured Knowledge Questionnaire, OSCE Stations with Checklist to Assess the Skill and Rating scale on staff nurses' acceptability towards the educational package on Bone Marrow Transplantation was used to collect data from all registered nurses who met the inclusion criteria.

Result: The study revealed that, in the Control group, 60% of them had moderately adequate knowledge in the pre-test and post-test tests. Whereas, in the Experimental group, 60% of staff Nurses had moderately adequate knowledge in the pre-test and after providing a Multimodal teaching Program on BMT, most of the staff nurses (80%) had adequate knowledge. The level of acceptability of the Multimodal Teaching Program on Bone Marrow Transplantation was highly acceptable to the staff nurses in the experimental group (100%)

Conclusion: The multimodal teaching program was effective in improving the knowledge and skill of staff nurses regarding Bone Marrow Transplantation. Multimodal teaching method is a powerful teaching tool that can be incorporated into nursing to improve the competency and performance of the staff nurses while taking care of patients with a need for Bone Marrow Transplantation.

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Keywords: Bone Marrow Transplantation; Multimodal Teaching Program; OSCE (Objective Structured Clinical Examination); Hematopoietic stem cells; Evidence-based practice

1. Introduction

With technological advancements, bone marrow transplantation (BMT) has evolved as a life-saving treatment. Nurses are essential members of the multidisciplinary team (MDT), providing continuous physical, psychological, and emotional support from admission through long-term follow-up. They act as patient advocates and sources of inspiration during this rigorous process.

BMT began in the 1950s with animal studies and achieved its first successful human application in 1957. India's first successful allogeneic BMT was performed in 1983 at the Tata Memorial Hospital, Mumbai. Transplants can be autologous (using the patient's cells) or allogeneic (from a donor), with stem cells sourced from bone marrow, peripheral blood, or cord blood. In India, over 19,000 transplants have been performed, with a survival rate of 71.7% (CIBMTR, 2010–2012).

Nurses play a crucial role in all BMT phases: pre-transplant, immediate post-transplant, and late post-transplant. Pre-transplant care includes patient preparation, chemotherapy administration, managing side effects, patient and family education, and supportive care.Caring for patients with graft-versus-host disease (GVHD) requires advanced knowledge and skills to manage complex side effects, assess patients, and administer specialized treatments. It is essential to regularly update nurses' knowledge and practices through education to reduce complications and improve outcomes.After myeloablative conditioning, patients often face pancytopenia for several weeks, with neutrophil recovery varying by graft type: about 2 weeks for peripheral blood stem cells, 3 weeks for bone marrow, and up to 4 weeks for cord blood. Full immune system recovery takes several months to years, requiring prolonged supportive care (Mosaad, 2014). Through expertise and compassionate care, nurses ensure exceptional support for BMT patients and their families at every stage of this demanding treatment journey.

1.1. Objectives of the Study

1.1.1. Primary Objectives

- To assess the level of knowledge and skill on Bone Marrow Transplantation among staff nurses.
- To determine the effectiveness of a Multimodal teaching program on Bone Marrow Transplantation on learning outcomes (Knowledge and Skill) of staff nurses

1.1.2. Secondary Objectives

- To determine the level of acceptability of the Multimodal Teaching Program on Bone Marrow Transplantation among the experimental group of staff nurses.
- To find out the correlation between the knowledge and skill outcomes on Bone Marrow Transplantation among staff nurses.
- To find out the association of selected background variables with the level of learning outcomes on Bone Marrow Transplantation among the control and experimental groups of staff nurses.

1.2. Research Hypotheses

- **H1**- There will be a significant difference in learning outcomes on Bone Marrow Transplantation in the Control and Experimental Group of staff nurses.
- **H 2**- There will be a significant difference in learning outcomes on Bone Marrow Transplantation before and after the Multimodal Teaching Program on BMT in the control and experimental group of nurses.
- **H 3**- There will be a significant correlation between the knowledge and skill on Bone Marrow Transplantation among staff nurses.
- **H 4**- There will be a significant association of the selected background variables with the level of learning outcomes on Bone Marrow Transplantation among the control and experimental groups of staff nurses.

2. Materials and Methods

Quantitative true experimental research approach was used to assess the Effectiveness of Multimodal Teaching Program on Bone Marrow Transplantation at Apollo Cancer Centre, Chennai. Quasi-experimental design was adopted in this study. The sample size was 60 and was selected based on the inclusion criteria. The samples were selected by the total enumerative sampling technique. The samples from the sampling frame were randomised to the control and experimental group (30 staff nurses to each group) by odd and even method.

2.1. Inclusion Criteria

- This study included the staff nurses who were
- Staff Nurses who are working in BMT, IHDU, Pediatric ward and PICU
- Willing to participate
- Present during data collection

2.2. Exclusion Criteria

- Staff nurses who are on long absence

2.3. Procedure methodology

A questionnaire was developed to assess the knowledge of staff about bone marrow transplantation through an extensive review of the literature and content validity with the experts in the field of Oncology medicine

The tools for data collection included the following

- Background Variables Proforma of staff nurses
- Structured Knowledge Questionnaire on Bone Marrow Transplantation
- OSCE station with Observational Checklist for Skill in Bone Marrow Transplantation
- Rating Scale on Acceptability of Multimodal Teaching Program on Bone Marrow Transplantation

Ethical clearance was obtained to conduct the study. The data was collected for a total period of 4 weeks from the selected samples. The pre-test was done by administering the pre-determined data collection instruments to the control and experimental groups of staff nurses. The baseline characteristics were obtained using the Background Variables Proforma, and the knowledge among staff nurses on Bone Marrow Transplantation was assessed using a self-administered. Structured Knowledge Questionnaire and the staff nurses' skills were assessed using the OSCE checklist.

The Multimodal Teaching Program was given for the experimental group of 30 staff nurses, as a two-day Multimodal teaching program on Bone Marrow Transplantation. The first day of the Multimodal Teaching Program had content such as videos and a PowerPoint presentation, which was provided for 1 hour. On the second day, a lecture cum discussion using PowerPoint presentation followed by a demonstration on Central Line Care, Neutropenic Care, and administration of medication and blood products, was done for 2 hours. Knowledge was assessed using a Structured Knowledge Questionnaire, and post-assessment of skill was assessed by OSCE.

After one week of the intervention, post-test assessment of knowledge was obtained through the Structured Knowledge Questionnaire and the assessment of skill obtained by the OSCE Checklist for the manned station, was done individually for staff nurses (15 staff nurses per day for 2 consecutive days) and checklist was used for the unmanned stations. The feedback was obtained from the experimental group of students using the Rating scale on the acceptability of the Multimodal Teaching Program on Bone Marrow Transplantation. The responses were coded, organized, tabulated, and analyzed using descriptive and inferential statistics and the findings were interpreted.

3. Result

As per the objectives, the data were collected and analyzed. The results were presented as

3.1. Section 1: Findings related to demographic variables of the staff nurses

Table 1 Frequency and Percentage Distribution of Background Variables of Staff Nurses in the Control and Experimental Groups

Background variable	Control group (n=30)		Experimental group (n=30)	
	f	%	f	%
Age (years)				
22- 24	27	90	25	84
25 -27	3	10	4	13
28 -30	0	0	1	3
Gender				
Male	0	0	3	10
Female	30	100	27	90
Qualification				
GNM	2	7	1	3
P.B. Diploma	1	3	1	3
B.Sc. Nursing	27	90	28	94
Year of Experience in BMT				
< 2	27	90	20	67
2 to 5	2	7	8	23
> 5	1	3	2	10

The data as per Table 1 reveals that the majority of the staff nurses were (100%,90%) females, aged 22-24 years (90%, 84%), studied B.Sc. Nursing (90%,94%) and have a working experience of less than 2 years in BMT (90%, 67%) in the control group and experimental group respectively.

3.2. Section 2: Percentage distribution of Years of Experience in BMT of staff nurses in Control and Experimental Group of staff nurses

Graph 1 shows that, with regard to total years of experience, the majority of staff nurses have a working experience of less than 2 years (90%, 67%) in the control group and experimental group respectively.

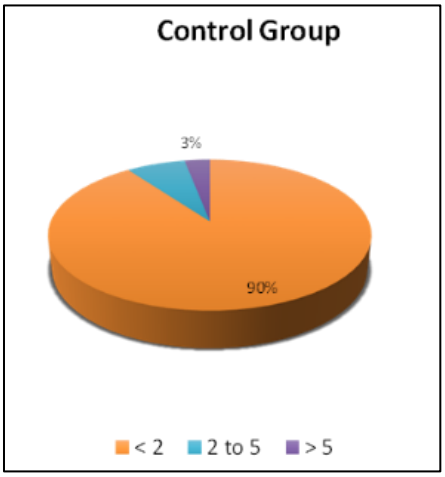

Figure 1 Percentage distribution of Years of Experience in BMT of staff nursesin the Control Group of staff nurses

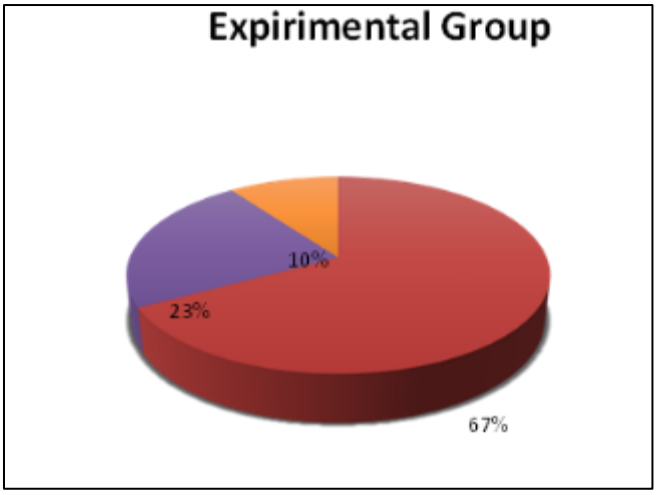

Figure 2 Percentage distribution of Years of Experience in BMT of staff nurses in the Experimental Group of staff nurses

Table 2 Frequency and Percentage Distribution of Level of Pre-test and Post-test Knowledge Scores on Bone Marrow Transplantation among Staff Nurses in the Control and Experimental Group

Knowledge (Max Score- 25)	**Control group (n=30)**				**Experimental group (n=30)**			
	Pre-test		**Post-test**		**Pre-test**		**Post-test**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Adequate (19 -25)	5	17	9	30	11	37	24	80
Moderately adequate (13 -18)	18	60	18	60	18	60	6	20
Needs improvement (< 13)	7	23	3	10	1	3	0	0

The data in Table 2 denote that, in the Control group, 60% of them had moderately adequate knowledge in the pre-test and post-test tests. Whereas, in the Experimental group, 60% of staff Nurses had moderately adequate knowledge in the pre-test, and after providing a Multimodal teaching Program on BMT, most of the staff nurses (80%) had adequate knowledge.

Table 3 Frequency and Percentage Distribution of Level of Pretest and Post-Test Skill Scores on Bone Marrow Transplantation among Staff Nurses in the Control and Experimental Group

Levels	**Control group (n=30)**				**Experimental group (n= 30)**			
	Pre-test		**Post- test**		**Pre-test**		**Post-test**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Adequate (75% -100%)	30	100	30	100	30	100	30	100
Moderately adequate (50% -74%)	0	0	0	0	0	0	0	0
Needs Improvement (<50%)	0	0	0	0	0	0	0	0

The data from above Table 3 depicts that all of them (100%) had adequate skill in the pre-test and post-test after the Multimodal Teaching Program in the Control and Experimental groups.

Table 4 Comparison of Mean and Standard Deviation of Pre-test and Post-test Knowledge Scores on Bone Marrow Transplantation in Control and Experimental Groups of Staff Nurses.

Groups	Pre-test		Post-test		Mean Diff	Paired 't' & 'p-value
	Mean & (Mean %)	SD	Mean & (Mean %)	SD		
Control group (n=30)	14.7 (58.8)	3.81	16.9 (67.6)	3.58	2.2	t- 10.08. p <0.001.
Experimental group (n=30)	16.5 (66)	2.89	20.4 (81.6)	1.76	3.9	t -7.75 p <0.001.

The above table 4 shows that, the mean and standard deviation of the post-test knowledge score (M=16.9 and SD=3.58) on Bone Marrow Transplantation was slightly higher compared to the pre-test Knowledge score among staff nurses (M=14.7 and SD=3.81) with 't' value of 10.08 in the control group at p< 0.001 level. In the experimental group also, there was a significant difference in the Knowledge scores between the pre-test (M=16.5, SD=2.89) and post-test (M=20.4, SD=1.76) with a 't' value of 7.75 at p<0 .001 level.

Hence, research hypothesis H1 stating, "There will be a significant difference in learning outcome was accepted.

Table 5 Comparison of Mean and Standard Deviation of Pre-test and Post-test Skill Scores on Bone Marrow Transplantation among the Control and Experimental Groups of Staff Nurses

Groups	Pre-test		Post-test		Mean Diff	Paired 't' & 'p-value
	Mean & (Mean %)	SD	Mean & (Mean %)	SD		
Control group	96.5		97.3			t 3.88
		3.59		2.77	0.833	
(n=30)	96.5		97.3			p <0.001.
Experimental	95.7		98.8			t-7.43
		3.85		1.92	3.033	
group (n=30)	95.7		98.8			p < 0.001.

The above Table 5 shows that the post-test skill score (M=97.3, SD=2.77) was higher than the pre-test skill score (M=96.5, SD=3.59) in the control group at p<0.001 and in the experimental group, there was a significant difference in skill scores between the pre-test (M=95.7, SD=3.85) and post-test (M=98.8, SD=1.92) at p<0.001 level.

Hence the research hypothesis H1 stating," There will be a significant difference in learning outcome was accept

Table 6 Comparison of Mean and Standard Deviation of Pre-test and Post-test Knowledge on Bone Marrow Transplantation between the Control and Experimental Groups of Staff Nurses

Assessment	Control group (n=30)		Experimental group (n=30)		Ind 't' Value	p-value
Total score (25)	Mean & (Mean%)	SD	Mean & (Mean%)	SD		
Pre-test	14.7 (58.8)	3.81	16.5 (66)	2.89	-2.06	p=0.043.
Post-test	16.9 (67.6)	3.58	20.4 (81.6)	1.76	-4.9	p <0 .001

The findings from Table 6 indicate that there was a significant difference in the pre-test knowledge score between the control (M=14.7, SD=3.81) and experimental group (M=16.5, SD=2.89) with 't' value of 2.06 (p<0.05). There was also a significant difference in the post-test knowledge score between the control group (M=16.9, SD=3.58) and experimental group (M=20.4, SD=1.76) with a 't' value of -4.9(p <0.001)

Hence, the research hypothesis H1 stating that there will be a significant difference in the learning outcome on Bone Marrow Transplantation knowledge between the control and experimental group was accepted in the control group and experimental group, respectively (at p< 0.05, p<0.001).

Table 7 Comparison of Mean and Standard Deviation of Pre-test and Post-test Skill Scores on Bone Marrow Transplantation between Control and Experimental Group of Staff Nurses

Assessment	**Control group (n=30)**		**Experimental group (n=30)**		**Ind 't' Value**	**P value**
Total score (25)	Mean & (Mean%)	SD	Mean & (Mean%)	SD		
Pre-test	96.53 (96.6)	3.59	95.77 (95.7)	3.85	0.945	0.349
Post-test	97.3 (97.3)	2.77	98.8 (98.8)	1.92	2.33	p=0.023 p < 0.05.

The findings from Table 7 indicate that there was no significant difference in the pre-test skill score between the control group (M=96.5, SD=3.59) and experimental group (M=95.7, SD=3.85) with 't' value -1.006 (p > 0.05). However, there was a significant difference in the post-test skill score between the control group (M=97.3, SD=2.77) and the experimental group (M=98.8, SD=1.92) with a 't' value of 2.33 at (p< 0.05).

Hence, the research hypothesis H1 stating that there will be a significant difference in the learning outcome on BMT between the control and experimental group was rejected with regards to the pre-test (at p.0.05) and accepted with regards to the post-test (at p<0.05).

Table 8: Correlation between Knowledge and Skill Scores on Bone Marrow Transplantation in the Control and Experimental Group of Staff Nurses

Assessment	**Variables**	**Control group (n=30)**		**Experimental group(n=30)**	
		'r' value	**'p' Value**	**'r' Value**	**'p' Value**
Pre-test	Knowledge Vs	0.031	0.87	0.0164	p=0.93
Post-test	Knowledge Vs Skill	-0.0483	0.79	0.2885	p=0.13.

The data in Table 8 reveals that there was a weak correlation between knowledge and skill scores in the post-test of the experimental group and control group of staff nurses, which was not significant (p>0.05). Hence, the research hypothesis H3, "There will be a significant correlation between the knowledge and skill on Bone Marrow Transplantation in the control and experimental group of staff nurses" was rejected in the control and experimental groups.

Table 9 Frequency and Percentage Distribution of Level of Acceptability on Multimodal Teaching Program among Experimental Group of Staff Nurses

Level of Acceptability (n=30)	**f**	**%**
Highly Acceptable (24-30)	30	100
Acceptable (17-23)	0	0
Unacceptable (9-16)	0	0
Highly Unacceptable (≤8)	0	0

The findings in Table 9 reveal that the Multimodal Teaching Program on Bone Marrow Transplantation was highly acceptable to the staff nurses in the experimental group (100%).

Table 10 Association between the Pre-Test knowledge regarding Bone Marrow Transplantation and Demographic Variables of Staff Nurses

Variables	Control Group			Experimental Group		
	Up to Mean	Above Mean	chi-square & p-value	Up to Mean	Above Mean	chi-square & p-value
Age						
<24 years	12	15	NA	12	15	NA
> 25 years	2	1		1	2	
Gender						
Male	0	0	NA	2	1	NA
Female	14	16		11	16	
Educational Qualification						
GNM	2	0	NA	0	2	NA
B.Sc. Nursing & P.B.B. Sc	12	16		13	15	
Years of experience						
< 2 Years	13	14	NA	9	11	0.07 0.79
>2 Years	1	2		4	6	
Years of experience in BMT						
< 2 Years	13	14	NA	9	11	0.07 0.79
>2 Years	1	2		4	6	

The data in Table 10 reveals that there was no association between the pre-test level of knowledge and demographic variables of staff nurses in the experimental and control groups. Hence, the research hypothesis H4 stating, "There will be a significant association between the level of knowledge and skill with the demographic variables of staff nurses in the control and experimental group" was rejected (at $p>0.05$).

4. Discussion

4.1. To assess the level of knowledge and skill on Bone Marrow Transplantation among staff nurses

The study findings revealed that in the control group, 60% had moderately adequate knowledge in the pre-test and post-test. Whereas in the experimental group, 60% of staff nurses had moderately adequate knowledge in the pre-test and after providing a Multimodal teaching Program on BMT, most of the staff nurses (80%) gained adequate knowledge.

4.2. To determine the effectiveness of a Multimodal teaching program on Bone Marrow Transplantation on learning outcomes (Knowledge and Skill) of staff nurses

There was a significant difference in the pre-test knowledge score between the control ($M=14.7$, $SD=3.81$) and experimental group ($M=16.5$, $SD=2.89$) with 't' value 2.06 ($p<0.05$). There was also a significant difference in the post-test knowledge score between the control group ($M=16.9$, $SD=3.58$) and experimental group ($M=20.4$, $SD=1.76$) with a 't' value of -4.9($p <0.001$). Hence, the research hypothesis H1 stating, that there will be a significant difference in the learning outcome on Bone Marrow Transplantation knowledge between the control and experimental group was accepted in the control group and experimental group respectively (at $p< 0.05$, $p<0.001$).

There was a significant difference in the pre-test skill score between the control group ($M=96.5$, $SD=3.59$) and experimental group ($M=95.7$, $SD=3.85$) with 't' value -1.006 ($p > 0.05$). However, there was a significant difference in the post-test skill score between the control group ($M=97.3$, $SD=2.77$) and the experimental group ($M=98.8$, $SD=1.92$)

with a 't' value of 2.33 at ($p < 0.05$).Hence, the research hypothesis H1 stating that there will be a significant difference in the learning outcome on BMT between the control and experimental group was rejected with regards to the pre-test (at p.0.05) and accepted with regards to the post-test (at $p<0.05$).

So, it can be concluded that there is a significant increase in knowledge of the experimental group between the pre-test and post-test than the control group which may be attributed to the effectiveness of the intervention.

4.3. To assess the level of acceptability of the Multimodal Teaching Program on Bone Marrow Transplantation among an experimental group of staff nurses

The findings reveal that the Multimodal Teaching Program on Bone Marrow Transplantation was highly acceptable to the staff nurses in the experimental group (100%)

The findings are congruent with a similar study conducted by Wolfen's et al (2019) which showed the response to the 8 × 4 knowledge questions for all study groups and time points. The intervention group scored best, intervention group, with a mean of 27.34 correct answers and obtaining 85.4%, which is significantly better than the no-intervention group (79.6%)) ($p = .001$).

So, it can be concluded that the majority of the staff nurses had a high level of acceptability towards the Multimodal Teaching Program, which suggests that the Multimodal Teaching Program can be used to improve the knowledge and skill of staff nurses on Bone Marrow Transplantation.

4.4. To find out the correlation between the knowledge and skill outcomes on Bone Marrow Transplantation among staff nurses

There was a weak correlation between knowledge and skill scores in the post- test of the experimental group and control group of staff nurses, which was not significant ($p>0.05$). Hence, the research hypothesis H3, "There will be a significant correlation between the knowledge and skill on Bone Marrow Transplantation in the control and experimental group of staff nurses" was rejected in the control and experimental groups

There was no significant correlation between the previous knowledge and level of skill gained by the participants, so the Multimodal teaching program will be of benefit for improving knowledge and skill, regardless of their previous academic performance.

4.5. To find out the association of the selected background variables with the level of learning outcomes on Bone Marrow Transplantation among the control and experimental groups of staff nurses

However, there was no association between the selected background variables and the level of learning outcome. Insignificant association between selected background variables with level of learning outcome may be due to the small sample size. Hence, the program will be beneficial regardless of their background characteristics.

5. Conclusion

The study findings on the effectiveness of a Multimodal Teaching Program on Bone Marrow Transplantation among staff nurses in selected hospitals in Chennai revealed that the program was effective in improving both knowledge and skills. Despite a weak correlation between knowledge and skills, the program proved beneficial regardless of the nurses' backgrounds. Overall, these findings underscore the value of the multimodal teaching approach in strengthening nurses' competencies and enhancing patient care.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Ethical clearance to conduct the study was obtained from the Institutional Ethics Committee (IEC), Apollo College of Nursing, Chennai...

Statement of informed consent

Informed consent was obtained from all staff nurses before data collection, and confidentiality was maintained throughout the study.

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