

## Knowledge And Awareness About Nursing Interventions To Reduce Peripherally Inserted Central Catheter Occlusion For Cancer Patients: A Prospective Observational Study.

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### Abstract:

**Background:** The use of peripherally inserted central catheter (PICC) lines as many healthcare benefits for patients. Some patients have long term PICC to enable long term intravenous medication to be given regularly without the need for frequent peripheral cannulation. Many patients with PICC have poor vasculature due to frequent long-term invasive treatments. However due to their long-term nature and position in a patient's vein, PICC lines require care by staff who are specifically trained and competent to reduce the risk of infection, thrombosis or migration. Cancer patients are considered the most at risk of the consequences of catheter occlusion. Therefore, nursing interventions that can effectively reduce the occlusion of peripherally inserted central catheter (PICC) lines must be identified to ensure a smooth treatment

**Materials and Methods:** This prospective observational study was carried out on patients of Department of Oncology at Apollo Health city, Jubilee Hills, Hyderabad for a period of 6 months from August 2022 to January 2023. A total 52 adult subjects (both male and females) of aged  $\geq 18$  years were included in this study. A total of 50 staff nurses who were handling PICC line were involved in the study. A pre-test questionnaire was given involving the components of bundle care checklist of PICC line. After training post-test questionnaire was given and score was collected. During PICC line handling a thorough monitoring was done on the compliance of bundle checklist by a Senior nursing staff. And during monitoring each bundle care checklist component, compliance and non-compliance rate has been recorded by senior staff nurse involved in the study.

**Results:** A total of 52 patients with PICC line were included in the study and a total of 50 staff nurses working in the oncology unit handling the PICC line were included in the study. PICC line occlusion was found only in 4 patients (7.69%) of the population. There is a statistically significant difference in the pre-test and post-test questionnaire score among the staff nurses.

**Conclusion:** Educational programmes emphasising PICC-related knowledge and abilities for oncology nurses should all be encouraged to decrease blockage. These actions will almost certainly prevent or lessen PICC occlusions.

**Key Word:** PICC line, Occlusion, Flushing solution, Flushing technique

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### I. Introduction

The use of peripherally inserted central catheter (PICC) lines has many healthcare benefits for patients. Some patients have long term PICC to enable long term intravenous medication to be given regularly without the need for frequent peripheral cannulation. For that purpose, PICCs have become increasingly popular because they can be retained for almost a year and avoid the pain of repeated punctures, thereby protecting the superficial vein network in patients' upper limbs. The most frequent risk of PICCs is occlusion, which can occur

despite their widespread clinical usage. Other concerns include catheter line-associated bloodstream infection and upper extremity venous thromboembolism. Grauet al<sup>1</sup> reported a high incidence of occlusion with catheter removal resulting in all cases. Gonsalves et al<sup>2</sup> documented that patients with PICCs have a 7% risk of developing occlusion and that the risk of occlusion becomes higher as the number of days of catheter retention increases. There is an obstruction, the upper limb's venous pressure rises, causing varicosity, which then causes lymphedema.<sup>3</sup> Occlusion necessitates catheter removal, which disrupts the course of therapy and exacerbates the clinical situation while also increasing patient suffering and financial strain.<sup>4</sup>

PICC line blockage is so preventable and treatable, and these are crucial clinical care procedures. PICCs have grown in popularity because patients can use them for almost a year without experiencing the discomfort of repeated punctures, protecting the superficial vein network in their upper limbs. The management and repair of peripherally placed central catheters is simple for nurses. The repercussions of catheter occlusion are thought to affect cancer patients the greatest. At most every seven days, PICC patients must go to the hospital for maintenance, during which 2% chlorhexidine solution is frequently applied to the skin to prevent infection.<sup>5</sup> If the PICC won't be utilised for a while, a nursing care maintenance method is used.<sup>6</sup> In order to effectively avoid or reduce PICC line blockage, nurse interventions are crucial. To guarantee a smooth course of therapy, nursing actions that can successfully lower the blockage of peripherally inserted central catheter (PICC) lines must be discovered.

Peripherally inserted central catheters can be easily repaired and managed by nurses. Moreover, PICC maintenance is relatively easy, considerably reducing medical expenses.<sup>7</sup> These characteristics suggest that PICCs can be ideal lines for cancer patients.

We conducted this study with an aim to evaluate nursing interventions to minimize PICC line occlusion, to improve awareness about PICC line care among nurses and to evaluate the effect of PICC line care compliance on PICC line-associated occlusion in cancer patients. This study was also done to make recommended measures for preventing or decreasing occlusion rate of PICC line in oncology patients from Department of Oncology from Apollo Hospitals, Jubilee Hills, Hyderabad.

## **II. Material And Methods**

This prospective observational study was carried out on patients of Department of Oncology at Apollo Health city, Jubilee Hills, Hyderabad for a period of 6 months from August 2022 to January 2023. A total 52 adult subjects (both male and females) of aged  $\geq 18$  years were included in this study.

**Study Design:** Prospective observational study

**Study Location:** This was a tertiary care teaching hospital based study done in Department of Oncology, at Apollo Health city, Jubilee Hills, Hyderabad.

**Study Duration:** 6 months from August 2022 to January 2023

**Sample size:** 52 patients.

**Sample size calculation:** A total of 52 patients who came to the Department of Oncology during the study period were included.

**Subjects & selection method:** The study population of 52 patients was drawn from oncology department who had PICC line inserted  $< 6$  months for chemotherapy, nutrition purpose, blood transfusion and hyperhydration for neutropenia. A total of 50 registered staff nurses who were handling PICC line in the oncology unit were involved in the study.

**Inclusion criteria:**

1. All cancer patients with PICC line inserted  $< 6$  months
2. Age  $\geq 18$  years
3. Registered staff nurses working in the oncology unit

**Exclusion criteria:**

1. Cancer patients with PICC line  $> 6$  months
2. Pregnant women
3. Age  $\leq 18$  years
4. Patients with a history of drug or alcohol abuse.

### **Procedure methodology**

The study was conducted after Institutional Ethics Committee approval. The study population of 52 patients was drawn from oncology department who had PICC line inserted  $< 6$  months for chemotherapy, nutrition purpose, blood transfusion and hyperhydration for neutropenia. A total of 50 staff nurses who were handling PICC line were involved in the study. A pre-test questionnaire was given involving the components of bundle care checklist of PICC line. After which a thorough training was done by a Senior Anesthesiologist and Nursing Supervisors to all the staff nurses involved in the study. After training post-test questionnaire was given and score was collected. During PICC line handling a thorough monitoring was done on the compliance of

bundle checklist by a Senior nursing staff. And during monitoring each bundle care checklist component, compliance and non-compliance rate has been recorded by senior staff nurse involved in the study. All PICC lines must be flushed weekly with heparin if not in use. In hospital patients it should be flushed following any use with 0.9% sodium chloride flush (before and after sample collection, before, after and in-between medication administration) or atleast once a day if not in use with heparin saline. They should be flushed with at least 10ml 0.9% sodium chloride (or alternative as indicated by the care plan) to prevent occlusion, using the push pause positive pressure technique. No syringe smaller than 10 ml should be used to flush PICC lines due to the risk of rupture. There are 8 components of the bundle checklist. They are

1	Hand hygiene
2	Maximal barrier precautions
3	Sterile gloves and clean the needle free injection port with 2% chlorhexidine swab and allow to dry for 30 seconds
4	'Push, pause' Method used while flushing lines
5	Ensure good back and forward flow is present if not notify
6	Minimum size 10 ml syringe 10ml of 0.9% Sodium Chloride or Heplock solution blood sampling, the PICC line must be flushed with 20mls 0.9% sodium chloride in a 20 ml syringe
7	Flush the line in between each IV medication being administered with 10mls of a compatible solution
8	Inspect the catheter exit site for signs of damage, migration (of more than 2cms from original length) & infection – swelling, redness, back flow or forward flow concern or oozing. Notify the patient's referring clinician or team if there are

Bundle checklist has been designed based upon the Hospital Standard of precautions

**Variables used in the study:**

- Pre-training Assessment and score
- Post-training Assessment and score
- Bundle compliance in percentages
- Factors leading to Non-Compliance

**Statistical analysis**

All the qualitative factors like pre and post-test score, Hand Hygiene, Maximal Barrier Precautions, remarks,etc. represented with the frequencies and percentages.All the quantitative parameter PICC Score represented with means and standard deviation.To compare the mean difference between pre and post PICC Score we used paired t-test. To compare compliance rate between different parameters of pre and post we used proportion test. All the data entered in MS. Excel and analyzed by using SPSS23.0v. p value less than 0.05 will be considered as significant.

**III. Result**

A total of 52 patients with PICC line were included in the study and a total of 50 staff nurses working in the oncology unit handling the PICC line were included in the study. PICC line occlusion was found only in 4 patients (7.69%) of the population.

The first step in the bundle checklist is proper hand hygiene. Hand hygiene compliance rate among staff nurses while handling PICC line before the test was 65.4%, while post-test the compliance rate is 90.4%. There is a significant difference in the compliance rate with a p value of 0.002.

The second step in the bundle checklist is following maximal barrier precautions. Maximal barrier precautions while handling PICC line was noted among the nurses. The compliance rate before the test was 61.5%, while after the test it is 86.5%. There is a statistically significant difference with a p value of 0.004.

The third step in the bundle checklist is wearing sterile gloves and clean the needle free injection port with 2% chlorhexidine swab and allow to dry for 30 seconds. Compliance rate of this step in handling PICC line pre-test is seen in 63.5% of staff nurses. And post-test compliance rate is seen in 86.5% of staff nurses. There is a clinically significant difference in compliance rate pre and post-test but the p-value is not statistically significant.

The fourth step in the bundle checklist is following ‘Push, pause’ Method used while flushing lines. The compliance rate of this step before the test is 42.3% and compliance rate post-test is 84.6%. There is a statistically significant difference in the compliance rate pre and post-test with a p value <0.001.

The fifth step in the bundle checklist is to ensure good back and forward flow. The compliance rate of this step pre-test is seen in 57.7% and compliance rate post-test is seen in 86.5%. There is a statistically significant difference in the compliance rate with a p value of 0.001.

The sixth step in the bundle checklist is to take a minimum size 10 ml syringe and 10ml of 0.9% Sodium Chloride or Heplock solution, for blood sampling the PICC line must be flushed with 20mls 0.9% sodium chloride in a 20 ml syringe. The compliance rate pre-test is 57.7% and post-test is 86.5%. There is a statistically significant difference in the compliance rate with a p value of 0.001.

The seventh step in the bundle checklist is to flush the line in between each IV medication being administered with 10mls of a compatible solution. The compliance rate of this step pre-test is 53.8% and post test is 92.3%. There is a statistically significant difference in the compliance rate in this step with a p value of <0.001.

The eighth step of the bundle checklist is to inspect the catheter exit site for signs of damage, migration (of more than 2cms from original length) & infection – swelling, redness, back flow or forward flow concern or oozing. The compliance rate of this step pre-test among the staff nurses is 73.1%. The compliance rate of this step post-test is 94.2%. There is a statistically significant difference in the compliance rate in this step with a p value of 0.004.

**Table 1 shows the comparison of compliance rate of each step in the bundle checklist pre and post-test**

Parameter	Compliance		P Value (Proportion Test)
	Pre-Test	Post-Test	
Hand Hygiene	34	47	0.002
Maximal Barrier Precautions	32	45	0.004
Sterile Gloves and Clean the Needle Sterile Gloves and Clean the Needle free Injection port with 2% Chlorhexidine Swab and Allow to Dry for 30 seconds	33	45	0.007
‘Push, Pause’ Method used while flushing lines	22	44	<0.001
Ensure good back and forward flow is present if not notify	30	45	0.001
Minimum size 10 ml syringe 10ml of 0.9% Sodium Chloride or Heplock solution blood sampling, the PICC line must be flushed with 20mls 0.9% sodium chloride in a 20 ml syringe	30	45	0.001
Flush the line in between each IV medication being administered with 10mls of a compatible solution	28	48	<0.001
Inspect the catheter exit site for signs of damage, migration (of more than 2cms from original length) & infection – swelling, redness, back flow or forward flow concern or oozing. Notify the patient’s referring clinician or team if there are any concerns.	38	49	0.004

**Table 2 shows pre-test and post-test questionnaire score comparison among the staff nurses**

PICC Knowledge Score	Mean	Std. Deviation	P Value (Paired t-test)
Pre-test	6.48	1.389	<0.001
Post-test	11.74	1.352	

There is a statistically significant difference in the pre-test and post-test questionnaire score among the staff nurses.

Among the staff nurses, pre-test remarks and post-remarks have also been collected as a part of the study to know the reason for non-compliance of the bundle checklist.

**Table 3 shows the remarks of the staff nurses for non-compliance of the bundle checklist pre-test**

Pre-Test Remarks	No. of Cases	Percentage
Busy Schedule	7	13.5%
Lack of Knowledge	30	57.7%
Training Issues	15	28.8%
Total	52	

**Table 4 shows the remarks of the staff nurses for non-compliance of the bundle checklist post-test**

Post-Test Remarks	No. of Cases	Percentage
Continues Trained	10	19.2%
Ongoing Training and Monitoring	33	63.5%
Training Issues	9	17.3%
Total	52	

#### IV. Discussion

In our study we found that the occlusion rate was only 7.69% (4/52). The incidence of PICC-related complications include infection in 15.9%<sup>8,9,10</sup>, thrombosis in 34%<sup>11,12,13</sup> and mechanical complications (i.e occlusion, accidental withdrawal) in 40.7%<sup>14</sup>.

Cancer patients had a higher rate of PICC line blockage than non-cancer patients. Cancerous coagulants are found in malignant tumour cells in cancer patients, changing the makeup of the blood and increasing blood viscosity. Furthermore, the PICC catheter can stay in the blood vessel for up to a year. To prevent thrombosis and infection, our hospital follows a policy of not keeping PICC lines in place for more than six months. The prolonged floating of the catheter in the blood arteries impairs blood flow and results in microvascular thrombosis at the catheter's tip. Several tumour cells simultaneously have the ability to release mucin and certain tissue factors, which can harm vascular endothelial cells, cause the production of the X-factor activator, and promote coagulation activity.<sup>15-17</sup> But in our study, the occlusion rate was only 7.69% because of good nursing care which got improved by continuous nursing training and interventions.

The use of good flushing technique, the use of the best flushing solution, nursing intervention through ongoing training and monitoring, and PICC types (valved and non-valved catheters) are all crucial nursing interventions to lower PICC line occlusion rates<sup>18</sup>. Education for nurses strongly related with PICC occlusion, however PICC type was not substantially associated with PICC occlusion, according to a meta-analysis conducted by Pan et al in 2019<sup>18</sup>.

The findings suggested that, in contrast to utilising only sodium for flushing, the blockage can be decreased by using heparin or combined heparin and saline to flush PICC. Additionally, using the push-pause-push technique every four hours was more efficient than using regular saline every six to eight hours.<sup>19,20</sup>

Correct flushing technique can help reduce occlusion occurrence. The findings showed that heparin is crucial for maintaining catheter patency by preventing catheter obstruction.<sup>21,22</sup> Heparin is a mucopolysaccharide ester made of glucosamine and glucuronic acid that is produced by mastocytes and basophilic granulocytes in animal bodies. Heparin's anticoagulant action can interact with antithrombin III to implement anticoagulant effects at the pentose active centre, but it cannot directly inactivate blood coagulation components. The arginine reaction centre conformation of antithrombin changes as a result of the interaction between heparin and the lysine of antithrombin III, leading to anticoagulant effects. Heparin can activate heparin cofactor II, which inactivates blood coagulation factor IIa, as an additional method.<sup>23-25</sup> According to the "Infusion Therapy Standards of Practice," 10 U/mL heparin is typically used to lock the catheter.<sup>26</sup> Push-pause-push pulse flushing can assist eliminate clots and medicines stuck to the catheter wall by spinning the catheter into a vortex. This lessens the likelihood of catheter blockages.

These all practices have been incorporated into our bundle checklist for care of PICC line. These are also a part of hospital SOP. The emphasis of putting the checklist into thorough practice is done by continuous nursing training and monitoring and by nursing education.

Nursing education is a very important tool to bring changes in the nursing practices and ultimately care of the patient. This study demonstrated that nurses' education can lower the incidence of occlusion. PICCs may not be well-known to nurses. The standardised PICC maintenance procedures are poorly understood by the majority of oncology nurses, and improper care could lead to catheter occlusion.<sup>27</sup> Additionally, nurses could be ignorant of thrombolytic therapies like urokinase or suctioning with a syringe that can be used to treat total blockage.<sup>28</sup> The catheter will be removed if attempts to remove the occlusion don't result in immediately noticeable benefits. When the catheter is flushed after a partial occlusion, the liquid would typically be challenging to push; nonetheless, this circumstance may be disregarded.<sup>29,30</sup> The accumulation from a partial occlusion causes complete occlusion to happen gradually. Such knowledge, in the opinion of oncology nurses, is essential and significant. To lower the frequency of occlusion and therefore enhance the quality of life of the patients, classes or lectures on the manifestations of occlusion, therapies, and practical operation during the therapy of patients receiving cancer treatment through PICCs can be provided<sup>30,31,32</sup>.

The effect of nursing training can also be seen on the compliance rate of each bundle checklist which showed a statistically significant difference pre and post-test in our study. Also, the pre-test and post-test questionnaire score has also changed and shown a significant difference.

## V. Conclusion

Patients' quality of life can be enhanced, and extra expenses can be cut by effectively lowering the occurrence of PICC occlusions. PICC occlusions were shown to be strongly correlated with nurses' knowledge and skills, flushing solution and method. The use of heparin as the flush, the push-pause-pushflushing technique, and educational programmes emphasising PICC-related knowledge and abilities for oncology nurses should all be encouraged to decrease blockage. These actions will almost certainly prevent or lessen PICC occlusions.

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