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Effectiveness of central line bundle care upon the knowledge and compliance staff nurses in the ICU

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ABSTRACT

Introduction Central venous access is one of the commonest procedures performed in acute care settings. The competence of staff nurses in caring for patients with Central Venous Catheters is an important determinant of quality patient outcomes and safety of patients in Intensive Care Units. *Materials & Methods* A pre-experimental study was done to assess the effectiveness of Central Line bundle Care upon Knowledge and Compliance regarding the Central Venous Catheter (CVC) among thirty Staff nurses from ICU's of a selected Hospital were selected using Purposive sampling. The intervention was the education of nurses on Central Line bundle care by teaching and demonstration of Care. Tools included the self-administered structured questionnaire for knowledge regarding CVC and a Practice Checklist adapted from the JCIA based on bundle Care. *Results* Majority of the Nurses belonged to the age group of fewer than 25 years (76.66%, 70%) and had an experience less than 2 years (83.33%, 60%). Education of Nurses on bundle care was done using power point and demo for the nurses. The Comparison of Pretest knowledge scores ($M=11.73$, $S.D=4.49$) and Post-test knowledge scores ($M=18.03$, $S.D=3.72$) regarding the Care of CVC of nurses showed a significant improvement with t value of 5.82 at $p<0.001$.

Keywords: Central venous catheter (CVC), Knowledge, Compliance, Staff nurses, Bundle care

1. BACKGROUND

Today's acute care settings are filled with the paraphernalia of high tech equipment and devices. Central venous access is one of the commonest procedures performed in many clinical settings for a variety of indications.¹ Central venous catheters (CVC's) are useful for, Emergency venous access, Central venous pressure monitoring, Volume resuscitation, frequent blood sampling, Nutritional support like TPN, transvenous pacing wire introduction, and Hemodialysis. Administration of medications such as vasopressors and chemotherapeutic agents can be done quickly and without occurrences of phlebitis.²

Central cannulation is the insertion of a CVC catheter which is a long, thin, flexible tube inserted through a femoral vein or the internal jugular vein and threaded to reach a the subclavian vein near the heart. There are several types of CVCs such as the PICC line, tunneled catheters or implanted ports.

The use of CVC is routine in critically ill patients and in fact, the European Prevalence of Infection in Intensive Care (EPIC) study reported that 78% of the patients had some form of CVC inserted.¹ CVCs are not without risks such as infection, thrombosis, and hemorrhage that are associated with increased mortality and morbidity.³ Health-care-associated infections (HAIs) affect 5% of patients hospitalized in the United States each year. CVC associated bloodstream infections (CLABSIs) are important and deadly HAIs, with a reported mortality of 12%–25%. The National Nosocomial Infections Surveillance System and the National Healthcare Safety Network (NHSN) estimated that out of the 15 million central vascular catheter (CVC) days (i.e, the total number of days of exposure to CVCs among all patients in the selected population during the selected time period) that occur in intensive care units (ICUs) in the U.S, each year there were 80,000 CRBSIs. A total of 250,000 cases of BSIs and 62, 000 deaths among patients in hospitals are estimated to occur each year.⁴

2. NEED FOR THE STUDY

In one of the studies carried out by prospective, observational method in the medical intensive care unit (MICU) in India in 2004, out of the 54 patients with CVCs for 319 Catheter days, 27.77% catheters were positive on Quantitative Culture. Among them, 18.52% had a catheter-associated infection. CRIs were high among catheters that were kept in situ for more than 3 days and emergency procedures where two or more attempts were required for catheterization or performed by inexperienced venupuncturists. Catheter-associated BSIs was 47.31 per 1000 catheter-days.⁵ A higher incidence was reported as 62.5% by

Positive tip culture.⁶ In a more recent study in India by where a rate of 46.7% was found. Coagulase-negative Staphylococci were the commonest in (40%) organisms isolated, with Pseudomonas in 25% and Candida in 20%. All 14 catheters in place for more than 11 days had a positive tip culture.⁷ Organisms are usually introduced into the hub from the hands of medical personnel. From this contaminated hub, the organisms migrate along the internal surface of the catheter, where they can cause a bloodstream infection.³

A prospective study report from a Paediatric ICU quotes a rate of 17.9%. Possible reasons could be due to the use of central catheters only for very sick children, three-way connector attachments to CVCs for increasing the number of infusions, the absence of dedicated IV catheter insertion teams, and the lack of standardized protocol for replacement/ change of catheters.⁸

There are also complications other than infection, which can present in an immediate or delayed fashion leading to significant morbidity and mortality. A retrospective study conducted of 1319 CVC catheter placement reported 12 mechanical complications and 128 infectious complications.³ These complications can cause a significant healthcare burden in cost, hospital days, and patient quality of life.

Advances in imaging, access technique, and medical devices have reduced complications, but still a vascular injury, infection, and misplacement does happen. Guidelines were outlined to provide evidence-based recommendations for preventing intravascular catheter-related infections.^{10,11} These guidelines also emphasized implementing bundled strategies and documenting and reporting rates of compliance with the bundle as benchmarks for quality assurance and performance improvement. These require continued effort by all health care providers and adequate training by nurses.¹¹

A Before-and-after study to determine the effectiveness of a care bundle, with a novel line maintenance procedure was done using CLABSI data reported to the Victorian Healthcare Associated Infection Surveillance System (VICNISS), in adult patients admitted to a tertiary adult ICU in regional Victoria. The intervention was a care bundle including a line insertion procedure and a novel line maintenance procedure comprising Biopatch, daily 2% chlorhexidine body wash, daily ICU central line review, and liaison nurse follow-up of central lines. The average CLABSI rate fell from 2.2/1000 central line days during the pre-intervention period to 0.5/1000 central line during the post-intervention period.

To improve patient outcome and to reduce healthcare costs, these efforts should be multidisciplinary, involving healthcare professionals who order the insertion and removal of CVCs, that personnel who insert and maintain intravascular catheters, infection control personnel and administrators. Staff reductions below a critical level may contribute to increasing catheter-related infection by making adequate catheter care difficult.¹² Programs for training nurses in long-term catheter care ("IV teams") were associated with a reduction in catheter-related infections in the USA. Nevertheless, without such teams the use of care protocols and nursing staff education allowed comparable results to be obtained.¹²

Some researchers have attempted to implement bundle care, including hand hygiene, maximal sterile barriers upon insertion, use of CHG for skin preparation, and avoidance of the femoral vein for the access site in this quality-improvement process, the overall compliance of all four bundles was only 50.3%. Moreover, the compliance of the optimal insertion site selection and the maximal sterile barrier was only 87% and 62%, respectively. In contrast, the compliance was more than 99% for hand hygiene and use of 2% CHG. It indicated that the process of surveillance instigation for adherence to these two CVC insertion bundles, maximal sterile barrier and optimal site selection, in other institutions.¹³

Many researchers from other countries have tried to assess knowledge of nurses. A descriptive study was conducted to assess the knowledge of healthcare workers (N = 100; 40 physicians, 60 nurses) about guidelines for the prevention of CVC-RI and adherence to these guidelines in practice. The knowledge scores were low with no significant difference between physicians' and nurses' knowledge (P = 0.134).¹⁴ Critical care nurses are responsible for administering, handling and maintenance of CVC's and more knowledge would translate into safe nursing practice and yield better outcomes for patients. Therefore, a quasi-experimental study to Effectiveness of Central Line Bundle Care upon the Knowledge and Compliance Staff Nurses in the ICU at a selected Hospital in Chennai was undertaken.

3. OBJECTIVES OF THE STUDY

To assess and compare the knowledge and compliance of staff nurses regarding Central Venous Catheter Care before and after Central Line Bundle Care.

Null hypothesis

There will be no significant difference in the knowledge and compliance regarding Central Venous Catheter of nurses before and after the intervention

Materials and Methods

A quantitative evaluative approach with a pretest/post-test research design was used in this study. The dependent variable is the knowledge and compliance of staff nurses regarding Central Venous Catheter Care. The study was conducted in a selected JCI accredited Corporate Hospital in Chennai, which has 730 beds of which 80 are ICU beds. The accessible population is 84 staff Nurses in the MDCCU and CT ICU working in various shifts.

Data Collection

Data was collected using tools such as the demographic variable and the structured questionnaire on knowledge regarding CVC care consisted of five subcomponent such as Parts of CVC, Procedure of Insertion, Nursing Care Of Patients on CVC, Complications, and Care Of CVC, each consisting of five questions and overall 25 questions were formulated.

The practice checklist was adapted from the JCIA based on bundle Care.

It consisted of 9 categories grouped into 3 Areas with 5 items each

- Hand Hygiene, Site Observation, Dressing Change 5
- Catheter injection port, Catheter Access, Infusate Preparation 5
- Administration Set Change, Removal of Catheter & Documentation 5

Performance as per the guidelines every day as taken as compliance and a score of 2 was allotted and if not as noncompliance with a score of 0. The total maximum score was 30. The pilot study was conducted for the structured questionnaire and reliability was established by split half method ($r=0.8$). The pretesting of the Practice checklist was done among 5 nurses caring for patients with central lines using the inter-rater inter-observer method in the HDU. The study was conducted after obtaining clearance from Ethics committee, Apollo Hospitals, Chennai, and informed consent were obtained from the participants. Sixty samples, 30 staff nurses of MDCCU and 30 staff Nurses from the CT ICU who were willing to participate in the study were selected by nonprobability, purposive sampling. The staff nurses completed the structured questionnaire within 15 minutes. The practice of staff nurses caring for patients with the Central line was observed by nonparticipatory observation using the checklist. The intervention to the staff nurses was administered by educating and demonstrating on Central Line Bundle Care. The score of < 15 indicated noncompliance; Score of 15 – 21 partial compliance: Score 22-30 indicated full compliance. The study was limited to nurses working in the critical care unit of the selected Hospital and caring for patients with central venous cannulae during the particular period of data collection. The data collection was completed within two weeks as they were on various shifts. The data were analyzed using descriptive statistics and inferential statistics.

4. RESULTS AND DISCUSSION

The demographic profile

The majority of the participants were aged between <25 years (76.6%, 70%), belonged to Hindu religion (53.33, 43.33), Qualification, had B.Sc.(N) as a qualification (76.66, 63.33) and were Females (90,86.66).



Fig 1: Percentage Distribution of total years of experience

Table 1: Percentage distribution of Level of knowledge of staff nurses before and after the Central Line Bundle Care (N=30+30)

Level Of Knowledge	Inadequate		Moderately Adequate		Adequate	
	n	%	n	%	N	%
Pretest	23	76.66	5	16.66	2	6.66
Post test	3	10	12	40	15	50

The present study reveals that the majority of nurses (50%) had an inadequate level of knowledge regarding CVC care and after the intervention 76.66% of nurses had an adequate level of knowledge. The findings correspond with the findings of a large study conducted in Calabria region (Italy) among health care workers to determine nurse’s knowledge regarding the guidelines for prevention of CRBSI among 3,405 ICUs nurses from European countries. The knowledge scores of physicians and nurses ranged from 43%-72% and the mean score was 44.4%.

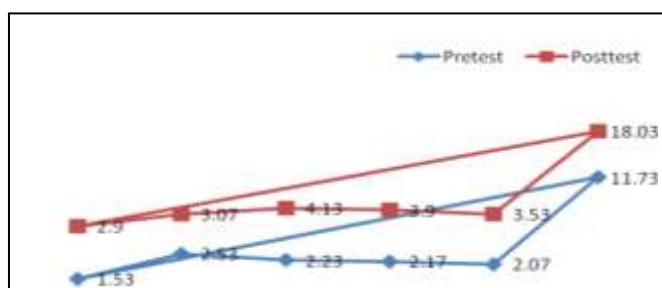


Fig. 2: Knowledge Scores of staff Nurses before and after the intervention

Comparison of the knowledge on CVC catheter among staff nurses before and after the intervention

Comparison of the pretest knowledge (Mean=11.73, S.D=4.49) regarding the maintenance of CVC catheter among staff nurses with the post-test knowledge scores (Mean=18.03, S.D=3.72) showed a significant difference with a t value of 5.82, $p<0.001$.

These results are similar to the findings of a descriptive cross-sectional study conducted among ICUs nurses in private tertiary care hospital in Peshawar using a Self-developed questionnaire regarding the self-reported practice of nurses regarding CVC care.

The knowledge score of intensive care unit nurses was M=73.65, S.D= 10.67.¹⁵The results indicate clearly that there is a lacuna in the knowledge of nurses who are the primary caregivers. Steps have to be taken to educate the Nurses regarding current guidelines and CVC bundle care in order to enhance their practice and yield quality patient outcomes

Table 3: Comparison of the Compliance Scores before and after the Central Line Bundle Care (N=30+30)

Categories	Pretest		Posttest		Paired t & p-value
	Mean	S.D	Mean	S. D	
Hand Hygiene, Site Observation, Dressing Change	3.9	0.76	6.23	0.94	12.04 p<0.001
Catheter injection port, Catheter Access, Infusate Preparation	3.53	0.63	5.7	0.65	20.04 p<0.001
Administration Set Change, Removal of Catheter & Documentation	3.7	0.79	7.13	0.89	16.14 p<0.001
Total (0 to 30)	11.13	1.28	19.03	1.50	26.266 p<0.001

Nurses play an important role in the prevention of CVC complication or CR-BSI through applying standard guideline such as maintaining aseptic environment during insertion of CVC for prevention of CVC related infections. The overall pretest compliance of nurses regarding the maintenance of CVC catheter was poor (Mean=11.73, S.D=4.49) compared to the post-test knowledge scores (Mean=18.03, S.D=3.72) and showed a significant difference with a t value of 26.26, p<0.001.

The level of practice of nurses during CVC insertion study was also considered to be poor overall as reported in the study¹³ using interrupted time-series design with historical control data in 29 PICUs across the United States. The intervention comprised of the insertion bundle of pediatric-tailored care elements and the maintenance bundle derived CDC recommendations. Average CA-BSI rates were reduced by 43% across 29 PICUs (5.4 vs 3.1 CA-BSIs per 1000 central-line-days; p = .0001). The compliance with insertion-bundle was 84% and maintenance-bundle compliance was 82%. Maximizing insertion bundle compliance and daily maintenance care using maintenance bundle will facilitate elimination of CA-BSIs for children.²¹

It may be concluded that nurses require additional training regarding CDC Guidelines for improving practice.

Association of the demographic variables of staff nurses with the knowledge on CVC catheter.

There was no association between demographic variables and the knowledge level of nurses in the CT ICU and MD CCU, though a similar study among 50 ICU nurses in a tertiary care centre in Pakistan found a significant association (p<0.05) between gender and practice.¹⁴ All nurses would benefit from ongoing education regardless of their demographic characteristics.

Implications

Procedure manuals and SOP's to be updated after review by experts regarding latest guidelines and evidence-based best nursing practices should implemented. An Innovative teaching drive regarding the newer devices, infection control practices and protocols in Critical Care for central-line insertion and maintenance and centralizing equipment should be undertaken. Audits and quality monitors are crucial for better patient outcomes.

Preventive strategies with the strongest supportive evidence according to Mermel^{9,16-20}

- Maximum barrier precautions during CVC insertion
- Subcutaneous tunneling short-term catheters inserted in the internal jugular or femoral veins when catheters are not used for drawing blood; Contamination shields for pulmonary artery catheters
- povidone-iodine ointment applied to insertion sites of hemodialysis catheters
- Specialized nursing teams caring for patients with short-term peripheral venous catheters
- No routine replacement of CVCs.

And if needed

- The antiseptic chamber filled hub or hub-protective antiseptic sponge for CVCs
- Chlorhexidine-silver sulfadiazine-impregnated or Minocycline-Rifampin-impregnated short-term CVCs.

5. CONCLUSION

Knowledge and practice of staff Nurses in the critical care unit regarding the maintenance are one of the most important determinants of quality nursing practice for better outcomes among patients in ICU's. The interventions described in this study could be easily implemented in other facilities regardless of their size or patient acuity.

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