Central line bundle maintenance among adults in a university hospital intensive care unit in São Paulo, Brazil: a best practice implementation project

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ABSTRACT

Objectives: This implementation project aimed to identify the current practice in regards to central venous catheters (CVCs) maintenance to improve knowledge amongst nursing staff and to assess increased compliance with evidence-based best practice.

Introduction: Central venous catheters are considered an important therapeutic resource for the administration of fluids, drugs, blood, collection of blood samples and hemodynamic monitoring. Despite the benefits, catheter use is associated with complications such as primary infection of the catheter-related bloodstream.

Methods: This project utilized the audit and feedback model using the Joanna Briggs Institute Practical Application of Clinical Evidence System. Nine of 10 criteria were audited through direct observation of nursing professionals or patient records in relation to CVC maintenance, and one criterion involved direct questioning of nursing staff. Baseline and follow-up audits were conducted in a 12-bed adult intensive care unit in a university hospital.

Results: The baseline audit revealed deficits between current practice and best practice in some criteria. Barriers to implementation of CVC maintenance best practice criteria were identified, and the strategies were implemented. The post-implementation (follow-up) audit showed improvement in compliance to best practice guidelines in all of the audit criteria, except in one criterion: the use of sterile gloves or surgical tweezers during the execution of the dressing.

Conclusions: Best practice in CVC care was achieved in the hospital, strengthening and guiding nursing care, as well as highlighting the importance of nursing records throughout the care process. However, this project highlighted the need to improve compliance through follow-up audits and periodic training to support best practice.

Keywords Catheter-related infections; catheters; clinical audit; evidence-based nursing; nursing care

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Introduction

The central venous access device (also known as a central venous catheter [CVC]) is a hollow tube inserted into a large vein located in the neck, arm or groin and should be anatomically located in proximity to the right atrium.[1,2] It is considered an important therapeutic resource in hospitalized patients, especially those in critical care units, where it is used among more than 80% of patients.[1,3] Central venous catheters are used primarily to administer fluid, drugs and blood products; allow blood samples to be taken for analysis; and monitor hemodynamic status.[4-6] The maintenance of CVCs is one of the primary aspects in ensuring the safety of these practices.

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Despite its important role in medical care, the use of a CVC is associated with complications that are hazardous to patients and involve costly treatment, for example, infection in the insertion site or systemic bloodstream infection.[2,7,8]

Central venous catheters are responsible for the highest proportion of healthcare-associated infections, with incidence rates of up to 2.7 per 1000 catheter-days.[7] The Centers for Disease Control and Prevention (CDC) estimates that approximately 72,000 central line associated bloodstream infections (CLABSI) occur annually in the United States in intensive care units and dialysis units, and that these infections result in an attributable mortality of 12%, an extra seven days of hospitalization per case, and excess costs of USD45,000 per episode.[9,10] In 2014, the National Health Surveillance Agency (ANVISA) in Brazil, referring to intensive care units (ICUs) of 1692 hospitals, highlighted the prevalence of laboratory confirmed bloodstream primary infections in adult ICUs as 5.1 per 1000 CVC-days.[11]

International and national organizations have developed guidelines and strategies for the prevention of catheter-associated infections, focusing on educational settings for professionals, catheter selection and site of insertion, and catheter insertion and maintenance care.[4,12-14] The Joanna Briggs Institute (JBI) is an international not-for-profit research and development organization that promotes and supports the synthesis, transfer and utilization of evidence.[15] Their recommendations for best practice regarding central catheter maintenance are:[5,6]

- A solution of greater than 0.5% chlorhexidine preparation with alcohol be used to cleanse the catheter site during CVC dressing changes. If necessary, tincture of iodine, an iodophor or 70% alcohol are alternative choices. (Grade B)
- Use of chlorhexidine impregnated dressing is safe and may be cost-effective in adult patients with a CVC. (Grade A)
- Either gauze and tape or transparent polyurethane dressings are acceptable types of dressings. Transparent dressings should be changed every seven days or sooner if they are no longer intact or moisture collects under the dressing. (Grade B)
- A gauze dressing needs to be assessed daily and changed with inspection of the insertion site or when the dressing becomes damp, loosened or soiled. A gauze dressing should be replaced by a transparent dressing as soon as possible. (Grade B)
- Intravascular devices that are accessed frequently should be flushed and locked with sterile normal saline for injection. (Grade B)
- A pulsated flushing technique (10 x 1 ml at a time) should be used when flushing catheter lumens. (Grade B)
- When locking the catheter a positive pressure technique should be used when disconnecting the syringe. (Grade B)
- The volume used to lock a catheter lumen should be sufficient to fill the entire catheter. (Grade B)
- While the evidence on the benefits and harms of anticoagulation remains unclear, it is recommended that patients with cancer with CVCs considering anticoagulation should weigh the potential advantages of reduced venous thromboembolism complications against the possible harms and disadvantages of anticoagulants. (Grade A)

These recommendations are based on the literature originating from a systematic review with meta-analysis, five systematic reviews, a randomized clinical trial, three evidence-based guidelines, a cost-benefit analysis and an expert opinion review paper.[4,13,16-26]

In the University Hospital of the University of São Paulo, the routine for insertion and maintenance of CVCs follows the recommendations of the Hospital Infection Control Committee (HICC),[27] which are based on the National Program for the Prevention and Health Care-Related Infections of ANVISA-Brazil and CDC guidelines.[13,14]

The University Hospital of the University of São Paulo is a public, secondary care complexity teaching hospital with 178 beds, distributed among medical clinic, surgery, pediatrics and obstetrics, located at the west area of the city of São Paulo, Brazil. It has an adult ICU (AICU) with 12 active beds which aims to attend to critical patients requiring clinical or surgical treatment, aged 15 years or over. In 2016, the average occupancy rate was 90.7%, the average length of stay was 6.5 days, the mean number of patients per day was 10.8 patients and the mortality rate was 21.5%.

The team of health professionals in the AICU comprises nursing staff, physicians, physiotherapists, nutritionists and pharmacists. The nursing staff consists of one chief, 17 nurse practitioners and 29 nurse technicians. Usually, the professional-bed ratio is one nurse for every six beds and one nursing technician for every two beds per shift (morning, afternoon and night). Nurse practitioners are responsible for the Nursing Process (assess the patient; list the nursing diagnoses; plan, implement and evaluate nursing care), execution of nursing care and supervising nurse technicians, who are responsible for the execution of nursing care.

In the AICU, the most commonly used CVC is the short-term, non-tunneled CVC, with an average annual use rate of 69.1% in 2016. The CVC hubs are connected to the needleless connector with neutral pressure, providing a simple fluid path with no internal mechanism (type BD Q-Syte®). The care of CVC maintenance is prescribed by the nurse practitioner and performed by a nurse or nursing technician, based on the national and international guidelines cited above.

The motivation for selecting this topic as a best practice implementation project for the JBI Evidence-based Cilinical Fellowship Program was the increase in bloodstream infections related to CVCs in the AICU of the University Hospital of the University of São Paulo in July, August and September 2016. At that time, the incidence rate of bloodstream infections per 1000 catheter-days had been rising, reaching epidemic levels and peaking in August, with nine infections per 1000 catheter-days. This raised concerns as no cases of infection had occurred in the previous seven months (December 2015 to June 2016). Infection prevention measures, such as training professionals on hand hygiene and care for the insertion and maintenance of CVC, were reviewed. Furthermore, it was critical to evaluate current practices and to implement best practice in CVC maintenance for the prevention of catheter-related bloodstream infections. This implementation project used the clinical audit and feedback strategy on central line maintenance practices to promote healthcare change/evidence-based practice and better outcomes for patients. The audit criteria used in this project were derived from the definitions of best practice from JBI.[5,6]

Aims and objectives

The aim of this best practice implementation project was to promote evidence-based practice in central line bundle maintenance in AICU and thereby contribute to the reduction of catheter-associated bloodstream infections, improving patient's health outcomes and resource utilization.

By implementing evidence-based practice in central line bundle maintenance, the project objectives were to:

- Assess current practices in central line bundle maintenance in an AICU using a baseline audit and an audit tool developed by JBI.
- Improve knowledge of best practice regarding central line bundle maintenance amongst nursing staff.
- Assess the extent and nature of increased compliance with evidence-based best practice regarding central line bundle maintenance.

Methods

This evidence implementation project used the Joanna Briggs Institute Practical Application of Clinical Evidence System (JBI PACES) and Getting Research into Practice (GRiP) audit and feedback tool to assess compliance with best practice in central line bundle maintenance. This project consisted of three phases over a period of six months, from November 2016 to May 2017. The three phases of the project are described below.

Ethical considerations

This project was submitted and approved by the Ethics Committee of the University Hospital of the University of São Paulo (CAAE number 64348017.2.0000.0076) and was conducted in agreement with Resolution 466/12 of the Brazilian Health Council.[28] A Post Informed Consent Form was not applied due to the nature of the study (quality improvement activity).

Phase 1: Baseline audit

Establishment of the audit team

A core group of key stakeholders was formed to support this project, and coordinated by the project leader, the chief nurse of Education and Quality Service at the University Hospital of the University of São Paulo. She was responsible for training the

nursing staff and managing nursing indicators, as well as collaborating in the implementation of best practice in the hospital.

Relevant key stakeholders were one registered nurse (RN) of the Education and Quality Service, one RN of the HICC, one chief nurse and two nurse practitioners (NP) of the AICU and the director of Clinical Division of Nursing Department. The project team was responsible for data collection, the training program and supervision of the best practice implementation.

Definition of audit criteria

To determine current levels of compliance with best practice recommendations, this project used the ten evidence-based audit criteria from JBI PACES related to central line bundle maintenance. The best practice recommendations were:

- Criterion 1: Removal of the central line or possible date of removal discussed daily during patient rounds.
- Criterion 2: Healthcare staff have received education and training in regards to management of central lines.
- Criterion 3: Gauze and tape dressing are changed daily.
- Criterion 4: Transparent dressing is changed every seven days or sooner if it is no longer intact or moisture collects under the dressing.
- Criterion 5: Hand hygiene is performed by the clinician prior to use of the central line.
- Criterion 6: Sterile gloves are used by the clinician prior to using the central line (or a sterile no-touch technique).
- Criterion 7: The clinician cleans the dressing area with 0.5% or higher chlorhexidine in alcohol solution.
- Criterion 8: The chlorhexidine solution is allowed to dry prior to accessing the central line.
- Criterion 9: A pulsated flushing technique (push-pause technique) is used when the catheter is flushed.
- Criterion 10: When parenteral nutrition is administered, a dedicated lumen is utilized.

These recommendations were adapted to our context in the following ways:

- Criteria 2, 5, 6 and 7: this project considered healthcare staff and clinicians as nursing staff conprising nurse practitioners, nurse technicians and resident nurses.
- Criterion 6: the use of sterile gloves or the use of surgical tweezers was considered during the CVC dressing exchange procedure.
- Criterion 8: this project considered alcohol at 70% instead of an alcohol solution of chlorhexidine, according to institutional routines,[27] based on the guideline of CDC 2011 and new guidelines of the Society for Healthcare Epidemiology of America (SHEA) 2014.[12,13]

Sample size

For this project, the sample comprised critical inpatients, aged 15 years or over, requiring clinical or surgical treatment in the AICU and requiring the use of a short-term non-tunneled CVC. Central venous catheters of the Shilley type were excluded because these CVCs are manipulated only by the nursing staff of hemodialysis. We evaluated 13 patients in the baseline audit, and 11 patients in the post-implementation audit.

The sample also comprised nursing staff from the AICU: 18 NPs and 29 nurse technicians. Nurses or technicians on regular leave or sick leave were excluded.

Baseline audit

A baseline audit was conducted prior to the best practice implementation over a period of 15 days, from February to March 2017. In addition, an assessment tool was used to collect data, as shown in Appendix I.

For criteria 1, 3, 4 and 7, we considered information in the daily records of patients with CVC. For criteria 5, 6, 8, 9 and 10, we considered direct observation of health professionals (NPs, resident nurses and nursing technicians) during daily activities in the ICU, including morning, afternoon and night shifts, with a focus on activities related to the care of CVCs. For criterion 2, the research team posed questions to the nursing staff about their training on the maintenance of CVCs.

Table 1 shows the evidence informed audit criteria used in the project (baseline and follow-up audits) together with a description of the sample and approach to the measurement of compliance with best practice for each audit criterion.

Prior to conducting the basic audit, the audit team performed pilot data collection using the data

Table 1: Audit criteria, sample and approach to the measurement of compliance with best practice

Audit criterion	Sample	Method used to measure % compliance with best practice
1. Removal of the central line, or possible date of removal discussed daily during patient rounds.	13 patients in the baseline audit, and 11 patients in the follow-up audit	- Checking the records of inpatients with CVC removal programming during daily rounds - Was considered met if there was a daily recorded description of maintenance or withdrawal schedule of the CVC, and stated as ''YES''.
2. Healthcare staff have received education and training in regards to management of central lines.	18 nurse practitioners and 29 nurse technicians	- Questioning nursing staff on whether training was performed on the maintenance of CVCs. - Was considered met if the nursing staff had training in the last 12 months in the hospital or outside the hospital, and stated as ''YES''.
3. Gauze and tape dressing are changed daily.	13 patients in the baseline audit, and 11 patients in the follow-up audit	- Checking the records of inpatients with a CVC that showed that the dressing made with gauze and tape was changed daily. - Was considered met if there was daily change of the CVC dressing recorded, and stated as ''YES''.
4. Transparent dressing is changed every seven days, or sooner if it is no longer intact or moisture collects under the dressing.	13 patients in the baseline audit, and 11 patients in the follow-up audit	- Checking the records of hospitalized patients with CVCs that showed that the dressing made with transparent film was changed every seven days or sooner if it was no longer intact or moisture collected under the dressing. - Was considered met if there was recorded change of the CVC dressing every seven days or sooner if it was no longer intact or moisture had collected under the dressing, and stated as ''YES''.
5. Hand hygiene is performed by the nursing team prior to use of the central line.	18 nurse practitioners and 29 nurse technicians	- Direct observation of hand hygiene immediately before manipulation of the CVC (blood collection, drug administration, dressing change, change of infusion systems). - Was considered met if the professional performed hand hygiene with alcoholic solution or soap and water immediately before manipulation of the CVC (blood collection, drug administration, dressing change, change of infusion systems), and stated as ''YES''.
6. Sterile gloves are used by the nursing team prior to using the central line (or a sterile no-touch technique).	18 nurse practitioners and 29 nurse technicians	- Direct observation of the professional during the execution of the dressing. - Was considered met if sterile gloves or surgical tweezers were used by the professional during the execution of the dressing with transparent film or with gauze and tape, and stated as ''YES''.

Table 1. (*Continued*)

Audit criterion	Sample	Method used to measure % compliance with best practice
7. The nursing team cleans the dressing area with 0.5% or higher chlorhexidine in alcohol solution.	13 patients in the baseline audit, and 11 patients in the follow-up audit	- Checking the records of hospitalized patients with CVCs in regards to performing the dressing with 0.5% chlorhexidine in alcohol solution. - Was considered met if the staff recorded that the dressing of the CVC was performed with 0.5% chlorhexidine in alcohol solution, and stated as "YES".
8. The 70% alcohol is allowed to dry prior to accessing the central line.	18 nurse practitioners and 29 nurse technicians	- Direct observation of the professional before accessing catheter hubs or needleless connector. - Was considered met if the professional vigorously applied mechanical friction with 70% alcohol before accessing catheter hubs or needleless connectors, and stated as "YES".
9. A pulsated flushing technique (push-pause technique) is used when the catheter is flushed.	18 nurse practitioners and 29 nurse technicians	- Direct observation of the professional during drug administration or blood collection. - Was considered met if the professional executed the pulsated flushing technique (1 ml at a time) when the catheter was flushed, after drug administration or blood collection, with an appropriate syringe size of at least 10 mL diameter, and an adequate flush volume (recommended as twice the internal volume of the catheter and extensions), and stated as "YES".
10. When parenteral nutrition is administered, a dedicated lumen is utilized.	13 patients in the baseline audit, and 11 patients in the follow-up audit	- Direct observation of the inpatients with a CVC and receiving parenteral nutrition. - Was considered met if the parenteral nutrition was administered in a dedicated lumen of the catheter, and stated as "YES".

collection instrument, as well as a meeting to coordinate the information to be collected.

The results of baseline audit are shown in Figure 1.

Phase 2: Implementation of best practice

The team members discussed the results of the initial audit. Using the JBI GRiP tool, barriers were identified in relation to best practice. Strategies were then identified to overcome the barriers, which were then implemented. The results of the JBI GRiP are shown in Table 2 below.

The team members were involved in brainstorming at this stage. This took place over a week, where audit results were discussed and barriers identified. Then possible strategies were discussed and an action plan was formulated and interventions for improving compliance implemented. The strategies were: i) elaboration of the evidence-based nursing protocol: "Maintenance of the Central Venous Catheter"; ii) review of the electronic nursing process, establishing the possible nursing diagnoses, results, interventions and nursing activities in maintenance of CVCs; iii) an educational program online

(WebQuest tool); iv) face-to-face meetings with the nursing team to highlight the main actions in maintenance of CVCs; v) realistic simulation about hand hygiene with the pedagogical box; vi) information sheet on hand hygiene regarding best practice in central line maintenance and electronic recording of the nursing process distributed to the nursing team (Appendix II).

Phase 3: Follow-up audit

The implementation team conducted the follow-up audit for one week (May 2017) using the same audit criteria as those used in the baseline. The methods used to measure compliance with best practice were the same as those used in the baseline audit, except for criterion 6 which was examined in patients' records and was considered met when the nurse prescribed the dressing of the CVC using the sterile technique and checked by nursing staff. The follow-up audit data were entered into JBI PACES and data analysis comparing follow-up results with those of the baseline audit were undertaken to examine any change in compliance rates.

The results of follow-up audit are shown in Figure 2.

Results

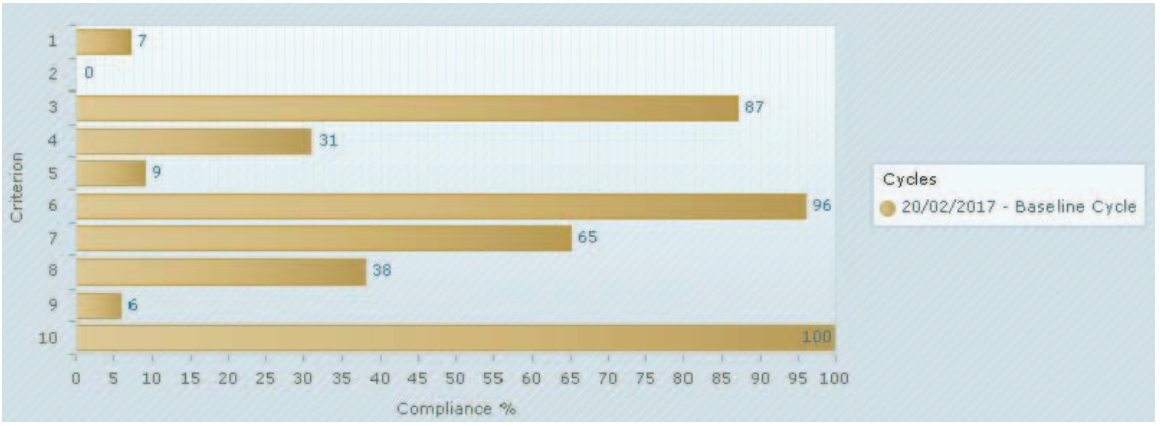
Phase 1: Baseline audit

The aggregated percentages of compliance with each audit criterion from the baseline audit are shown in Figure 1.

As can be seen in Figure 1, the best baseline performance was found in criterion 10, reaching 100% of cases, which measured the administration of parenteral nutrition in dedicated lumen of CVC. The criterion is well established and incorporated into healthcare practice. Furthermore, criteria 3 (gauze and tape dressing changed daily) and 6 (sterile gloves or surgical tweezers used during the execution of the dressing) reached 87% and 96%, respectively, indicating high compliance. Criterion 7 (cleaning the dressing area with 0.5% or higher chlorhexidine in alcohol solution) reached 65%, and was identified as moderate compliance. All other criteria were found to be less than 50%, indicating poor compliance with the current evidence.

Phase 2: Strategies for Getting Research into Practice (GRiP)

The main barriers, strategies, resources and outcomes identified are presented in Table 2.



Criteria legend

1. Removal of the central line, or possible date of removal discussed daily during patient round. (59 of 59 samples taken)
2. Healthcare staff has received education and training in regards to management of central lines. (47 of 47 samples taken)
3. A gauze and tape dressing has been changed daily. (39 of 39 samples taken)
4. A transparent dressing was changed every 7 days, or sooner if it is no longer intact or moisture collects under the dressing. (42 of 42 samples taken)
5. Hand hygiene was performed by the clinician prior to use of the central line. (102 of 102 samples taken)
6. Sterile gloves were used by the clinician prior to using the central line (or a sterile no-touch technique). (28 of 28 samples taken)
7. The clinician cleaned the dressing area with 0.5% or higher chlorhexidine in alcohol solution. (51 of 51 samples taken)
8. The chlorhexidine solution was allowed to dry prior to accessing the central line. (89 of 89 samples taken)
9. A pulsated flushing technique (push-pause technique) was used when the catheter was flushed. (77 of 77 samples taken)
10. When parenteral nutrition is administered, a dedicated lumen is utilized. (39 of 39 samples taken)

Figure 1: Baseline compliance with best practice for audit criteria (%)

Table 2: Getting Research into Practice matrix

Barrier	Strategy	Resources	Outcomes
There is no record of daily rounds	• Meeting with nursing and medical leadership. • Establish a routine registry about the need for catheter maintenance or withdrawal schedule of CVC in "ICU Patients Monitoring Chart". • Educational sessions.	• Computers • Multimedia • Meeting room • Electronic nursing process of hospital	• Meeting was conducted with nursing leadership and physician • "ICU Patients Monitoring Chart" under review and expected to be implemented in the near future. • Review of PROCEnf-USP and added to the activity "Ask the health team regarding withdrawal of the CVC during daily rounds". • 100% of nursing staff attended educational sessions.
There is no protocol on CVC dressings	• Elaboration of the procedure "Performing the dressing of CVCs", with indications for using of gauze and tape or transparent film dressing. • Educational sessions.	• Computers • Hospital information system • Meeting room • Multimedia	• An evidence-based protocol "Maintenance of CVC" was elaborated and the procedure "Performing the dressing of CVCs" was inserted, with indications for using gauze and tape or transparent film. • 100% of nursing staff attended education sessions.
There is no procedure for performing CVC dressings	• Elaboration of the procedure "Performing the dressing of a CVC". • Educational sessions.	• Computers • Hospital information system • Meeting room • Multimedia	• The procedure "Performing the dressing of catheter CVC" was added to the protocol "Maintenance of CVC" • 100% of nursing staff attended educational sessions.
Lack of knowledge among the nursing team about pulsated flushing technique	• Educational sessions.	• Computers • Hospital information system • Meeting room • Multimedia	• The procedure pulsated flushing technique was added to the protocol "Maintenance of CVC" • A video demonstrating the technique was utilized during training. • 100% of nursing staff attended educational sessions.
Lack of protocol on CVC maintenance	• Elaboration of protocol on CVC maintenance. • Educational sessions. • Review of the electronic nursing process.	• Computers • Hospital information system • Meeting room • Multimedia • Electronic nursing process of hospital	• An evidence-based protocol "Maintenance of CVC" was elaborated. The protocol was made available in the nursing manual, easily accessed via the intranet in hospital computers. • 100% of nursing staff attended educational sessions. • Established the nursing diagnoses, results, interventions and nursing activities in the "Maintenance of CVC" (Appendix II)

Table 2. (*Continued*)

Barrier	Strategy	Resources	Outcomes
Nursing professionals' lack of knowledge	• Educational sessions.	• Meeting room • Multimedia • WebQuest tool • Computers • Information sheets	• Prepared online training using the WebQuest tool (Appendix II). • Information sheets emphasizing evidence-based nursing care for the maintenance of CVC (Appendix II). • 100% of nursing staff attended educational sessions. • Distribution of information sheets in the unit and via email to the nursing team.
Low adherence to hand hygiene immediately prior to CVC manipulation	• Educational sessions.	• Pedagogical hand hygiene box • Alcoholic product and special liquid • Computers	• Two moments of realistic simulation using the pedagogical box among nursing staff were performed (Appendix II). • Emphasizing the Five Moments of Hand Hygiene. • Distribution of information sheets in the unit and via email to the nursing team (Appendix II). • In the first half of May, the hospital infection control commission and the patient safety group did an educational activity on hand hygiene through an educational game and a pedagogical box.
Technical problems with transparent film curative (loose, small)	• Routing the problem to hospital material management.	• Specific form for technical problems with hospital medical material	• Meeting was conducted with nurse material manager. • Filling in the form for technical problems, highlighting the main problems.

CVC: central venous catheter; ICU: intensive care unit.

We developed a protocol on maintenance of CVCs and included all evidence-based nursing care for the maintenance of CVCs. The protocol was approved by the intravenous therapy group of the Nursing Department of the Hospital and the RN of the HICC.

The main strategies to improve compliance with best practice in central line maintenance were an educational program for the nursing staff performed by the project leader and chief nurse of the education and quality service. An online training program was developed using the WebQuest tool. Training for AICU nurses was conducted and general orientation sent via email, with a maximum period of three weeks to be completed. We sent weekly reports of participation to the head of AICU, as well as individual emails encouraging the completion of training. The management of this training was carried out by the RNs of the teaching and quality service. We also promoted face-to-face discussions during work shifts (with a total of eight meetings) highlighting the main care of CVCs in which professionals participated, clarified their doubts on the subject and added to the simulation of hand hygiene using a specific tool called a pedagogy box for hand hygiene.

The hospital has a system of electronic documentation of the nursing process, called PROCEnf-USP, which is based on the structure of NANDA-International, NIC (Nursing Interventions Classification) and NOC (Nursing Outcomes Classification) classification systems. It performed a review of the electronic nursing process, establishing the possible nursing diagnoses, results,

interventions and nursing activities in the maintenance of CVCs.

Phase 3: Follow-up audit

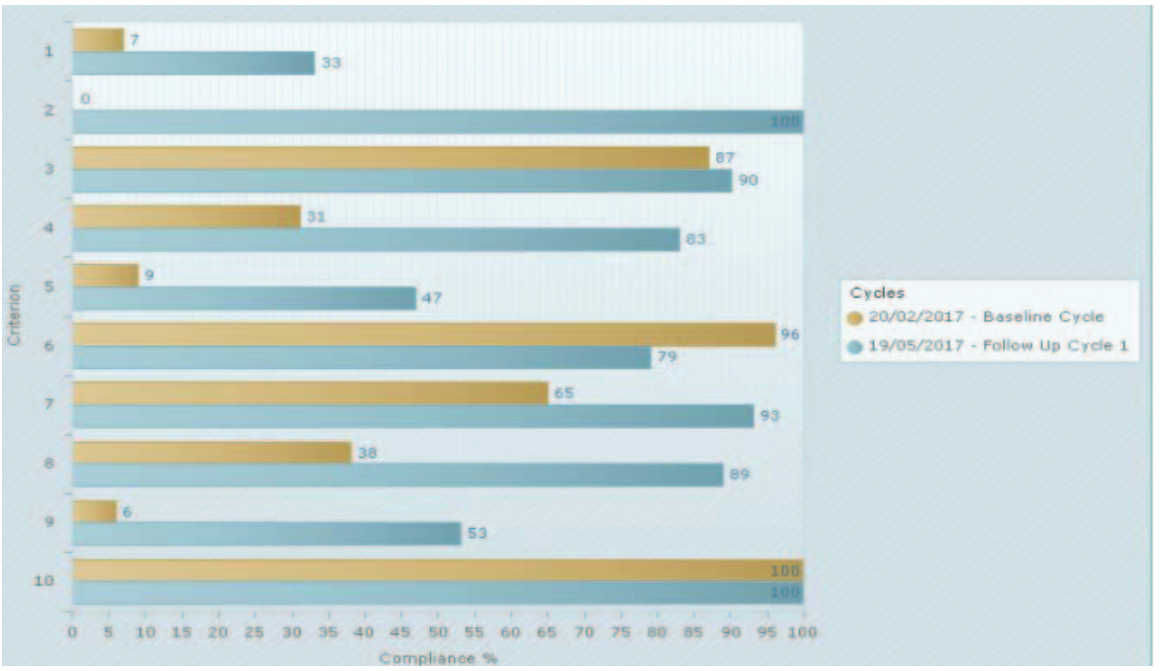
The follow-up audit was conducted two weeks after implementation of the strategies to improve compliance with best practices.

The percentage of compliance with best practice for the audit criteria in the baseline and follow-up audits is shown in Figure 2.

There was an improvement in all criteria audited, except for criterion 6 (sterile gloves or surgical tweezers are used during the execution of the dressing), for which compliance decreased in comparison to the baseline audit (from 96% to 79%). Both criteria 2 and 10 achieved 100% compliance, indicating that we managed to train all AICU nursing staff in maintaining the practice of administration in the exclusive route of parenteral nutrition. Although criteria 1 and 5 were found to be less than 50%, they showed an improvement in compliance as well, at 26% and 38%, respectively. The other criteria (3, 4, 7, 8 and 9), although not reaching 100% compliance, reached 90%, 83%, 93%, 89% and 53% respectively, showing an improvement in achieving compliance.

Discussion

This project aimed to improve current practice in central line bundle maintenance among AICUs, as a response to the increase of bloodstream infections related to CVCs. For this purpose clinical audits and education interventions were implemented to



Criteria legend

1. Removal of the central line, or possible date of removal discussed daily during patient round. (57 of 57 samples taken)
2. Healthcare staff has received education and training in regards to management of central lines. (47 of 47 samples taken)
3. A gauze and tape dressing has been changed daily. (41 of 41 samples taken)
4. A transparent dressing was changed every 7 days, or sooner if it is no longer intact or moisture collects under the dressing. (40 of 40 samples taken)
5. Hand hygiene was performed by the clinician prior to use of the central line. (74 of 74 samples taken)
6. Sterile gloves were used by the clinician prior to using the central line (or a sterile no-touch technique). (42 of 42 samples taken)
7. The clinician cleaned the dressing area with 0.5% or higher chlorhexidine in alcohol solution. (42 of 42 samples taken)
8. The chlorhexidine solution was allowed to dry prior to accessing the central line. (74 of 74 samples taken)
9. A pulsated flushing technique (push-pause technique) was used when the catheter was flushed. (62 of 62 samples taken)
10. When parenteral nutrition is administered, a dedicated lumen is utilized. (6 of 6 samples taken)

Figure 2: Compliance with best practice audit criteria in follow-up audit compared to baseline audit (%)

promote changes in practice, based on best practice, and a post-implementation audit to assess compliance with evidence-based best practice regarding central line maintenance.

Some practices were already established in the hospital and registered in patient records. Examples include the daily dressing change with gauze and tape every seven days or when the dressing is dirty, loose or moist, and cleaning of the CVC insertion with 0.5% chlorhexidine in alcohol solution. These are nursing activities, prescribed by the nurse and performed by the nursing team. It is necessary to reinforce the importance of recording in nursing care among the nursing team, as it consists of written communication of information pertinent to the patient and the care provided, an essential element in the care process, in addition to helping other purposes (research, audits, juridical processes and others) and being a legal aspect of the profession.

Other practices of the hospital had none of the information recorded, such as the execution of the dressing of the CVC in a sterile technique (criterion 6). In this criterion we changed the method of collecting data in the post-intervention audit. In the baseline audit the data collection was through direct observation, which proved to be a consolidated activity in the hospital. In the follow-up audit, we chose to collect this information from patients' records, more specifically in nursing prescription, as we had inserted this activity into the electronic nursing process. However, compliance in the follow-up audit decreased due to the lack of nurses' adherence to registering this information. Therefore, it is necessary to reinforce the importance of nursing records to the team.

The nursing staff in the ICU completed daily rounds and the multi professional team was asked about the need to maintain catheters and probes. No records on such activity were kept. In the baseline audit, we found only four CVC withdrawal records in the clinical evolution performed by the physician. The ''ICU Patients Monitoring Chart'' is under review (and is expected to be completed by the second semester), which will include questions about catheters and probes. For this project and to meet the current need, we reviewed the nursing process in the electronic system of the hospital and added the activity ''Ask the health team about the withdrawal of the CVC during the daily round''. However, we did not have the expected compliance in this regard and it is necessary to reinforce this aspect with the nurses.

Hand hygiene is a universal measure for reducing healthcare-related infections. The HICC promotes annual campaigns distributing posters throughout the year in the hospital elevators and sending emails to the professionals emphasizing the Five Moments of Hand Hygiene in order to disseminate the use of the alcohol product for care units every six months. Considering the low compliance of nursing professionals, we encouraged them through educational sessions, emphasizing the second moment (before the aseptic procedure), because the professionals sometimes perform various procedures on the same patient without washing their hands, but merely changed their gloves. The ICU has dispensers of alcoholic products next to the beds of patients, as well as sinks with soap and water, thus facilitating hygiene.

Low adherence to criteria 8 and 9 were observed in the baseline audit due largely to the majority of the professionals performing the disinfection of the connectors without the necessary friction, passing only the cotton with alcoholic solution through the surface of the connector, in addition to the lack of knowledge of the pulsated flushing technique among the nursing professionals. In the training, we used videos to show the technique, which led to improvement in compliance in both criteria. In addition to the audited criteria, we reinforced care in the training regarding the exchange time of the infusion systems.

The development of this project allowed the elaboration of the protocol evidence-based maintenance of CVC, since catheter care was described only in the CCIH manual and without a description of procedures, such as CVC dressing. In addition, it allowed the PROCEnf-USP to be reviewed, establishing the link between the NANDA-International, NIC and NOC in relation to CVCs and listing nursing activities for the maintenance of the catheter in nursing interventions. The nurses are familiar with the system, but the introduction of a bundle of activities in a single nursing intervention is new, requiring time for acceptance and adoption by the nurse practitioner, as well as an evaluation of this process. It is important to note that the tool used in this project for the implementation of evidence, clinical audits, allowed for reflection and a systematic review of the care practice, hence acting as a mechanism for self-assessment and quality improvement.

The main limitations of the project were: the time constraints, as we started the project after approval of the institution ethics committee, which shortened the collection period and consequently prevented us from obtaining a larger sample; the rate of catheter use in the ICU of only 69%, showing that not all the patients hospitalized in this unit made use of a CVC; and the methods for collecting data. Through direct observation, it was not possible to observe the activities performed by the professionals at all times. Also during the collection of patients' records, records failures can occur, as was observed in this project.

Future directions for promoting best practice highlighted as priorities by the project include: providing annual training in central line bundle maintenance and nursing records, conducting further clinical audits periodically to ensure quality of care and sustainability of practices, and evaluation of PROCEnf-USP in relation to the new strategy adopted in nursing activities. In addition, it is important to evaluate the cost-effectiveness of the implemented process, allowing an analysis of the clinical benefits of the evidence implemented in clinical practice and the associated costs.

Conclusion

This implementation project allowed the identification of best practice in CVC care being practiced by the institution, strengthening and guiding nursing care, as well as highlighting the importance of nursing records throughout the care process. The bundle maintenance is one of the steps necessary to contribute to the reduction of CLABSI rates. However, this report reflects the need to improve compliance, with the objective of achieving 100% compliance, through follow-up audits and periodic training to support best practices.

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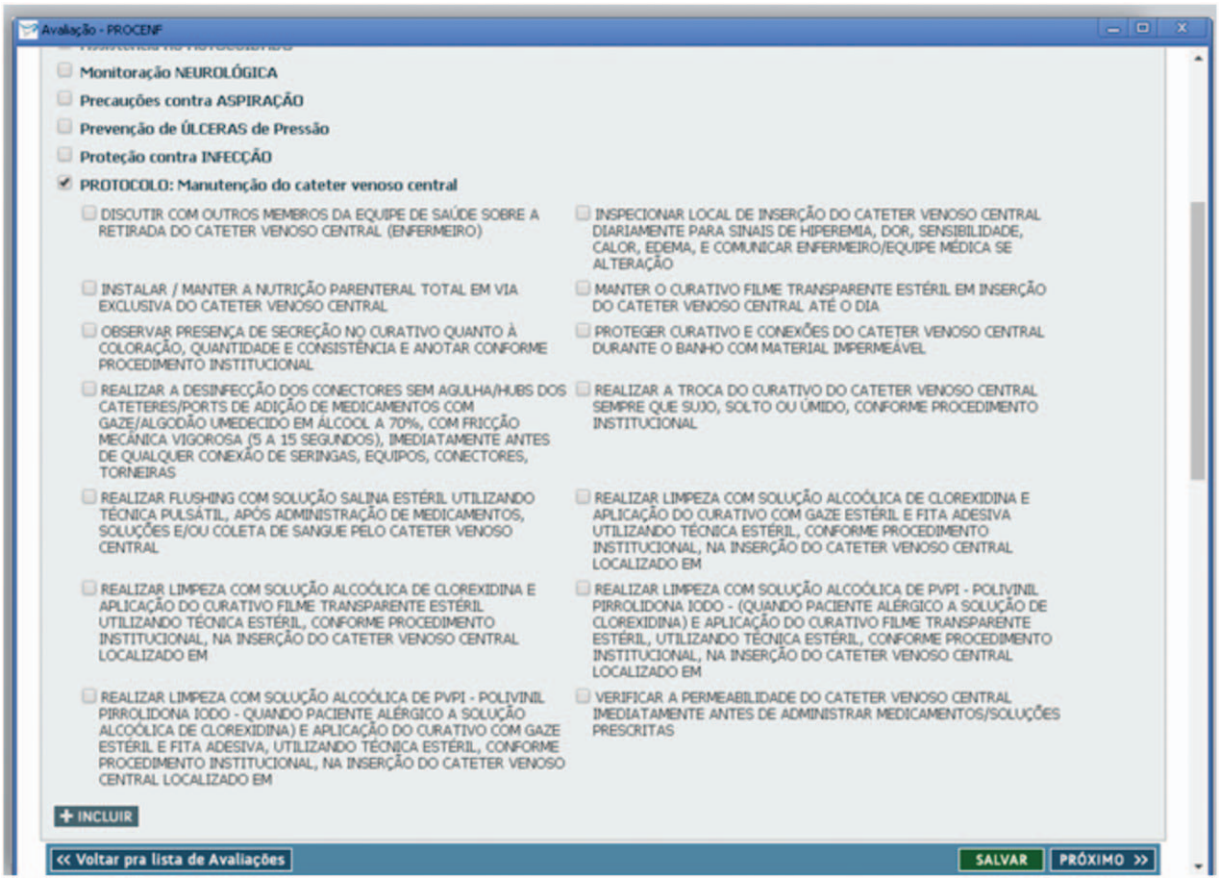
Appendix I: Instrument for data collection

	1			2			3			4			5		
CVC Types															
Criterion – Patients records	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**
1. Are there records of need for catheter maintenance or catheter withdrawal schedule during the daily round, inpatients with central venous catheter?															
3. Is there a record of the daily change of the dressing of the central venous catheter when performed with gauze and tape?															
4. Is there a record of the change of dressing transparent film of the central venous catheter every 7 days or sooner if it is no longer intact or moisture collects under the dressing?															
4.1. Is there a record of the change of dressing transparent film of the central venous catheter when sooner if it is no longer intact or moisture collects under the dressing?															
7. Is there a record that the dressing of the central venous catheter was performed with 0,5% chlorhexidine in alcohol solution?															
Observation															
Criterion – Direct Observation															
5. Has the professional done hands hygiene with alcoholic solution or soap and water immediately before manipulation of the central venous catheter?															
Observation															

(*Continued*)															
	1			2			3			4			5		
CVC Types															
Criterion – Patients records	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**	**Y**	**N**	**NA**
6. Has the professional used sterile gloves or surgical tweezers during the execution of the dressing with transparent film or with gauze and tape?															
Observation															
8. Has the professional applied vigorously mechanical friction with alcohol 70% before accessing catheter hubs or needleless connectors?															
Observation															
9. Has the professional executed the pulsated flushing technique (1 ml at time) when the catheter was flushed, after drugs administration or blood collection?															
Observation															
10. The parenteral nutrition was administered exclusively via the catheter?															
Observation															
Criterion – Ask professional															
2. In the past 12 months, did you receive training on maintenance of the central venous catheter, in the hospital or outside the hospital?															
Observation															

Appendix II: Strategies implemented for improving compliance

Nursing activities related to CVC maintenance
Reproduced with permission from Diley Cardoso Franco Ortiz



Information sheet on the electronic recording of the nursing process
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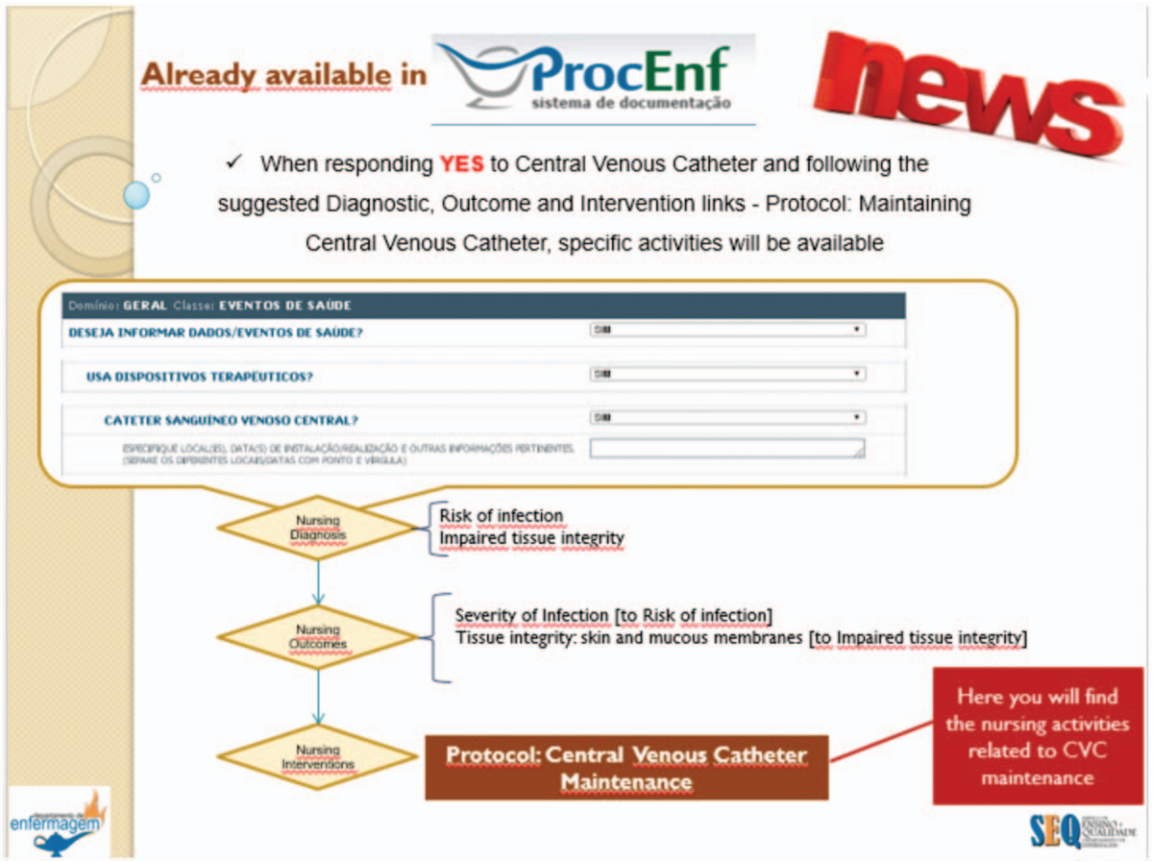

Information sheet on hand hygiene
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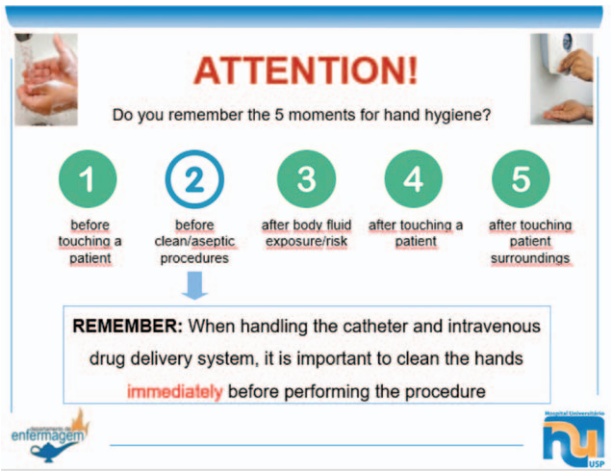

Information sheet on best practice in central line maintenance
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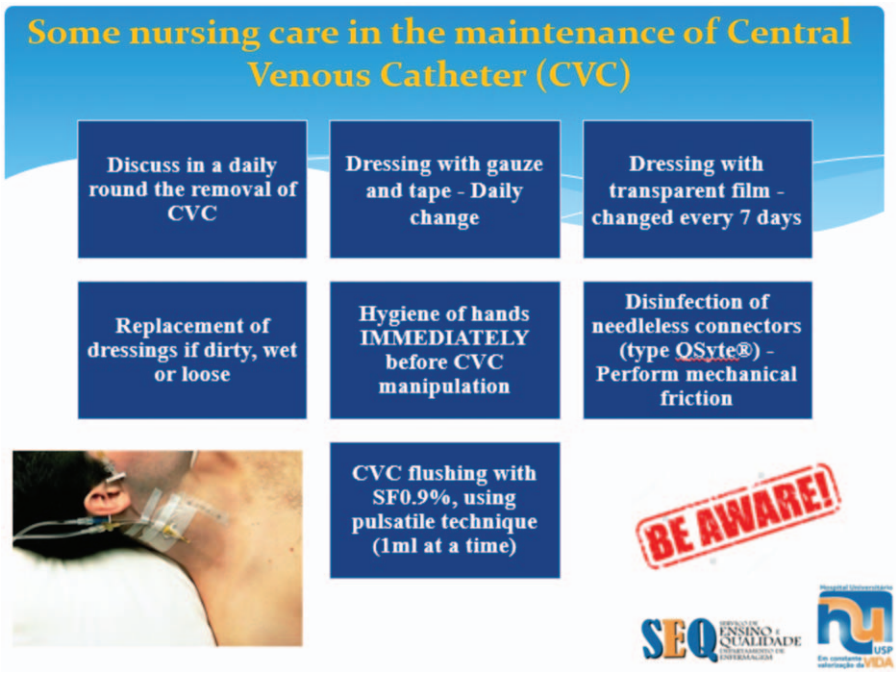

Educational program online (WebQuest tool)
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