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INTEGRATIVE REVIEW ARTICLE

HEALTH TEAM TRAINING IN HANDLING THE CENTRAL VENOUS CATHETER: INTEGRATIVE REVIEW

TREINAMENTO DA EQUIPE DE SAÚDE PARA O MANUSEIO DO CATETER VENOSO CENTRAL: REVISÃO INTEGRATIVA

ENTRENAMIENTO DEL EQUIPO DE SALUD EN EL MANEJO DEL CATÉTER VENOSO CENTRAL: REVISIÓN INTEGRADORA

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ABSTRACT

Objective: to synthesize the strategies of healthcare team training in handling the central venous catheter aiming to reduce and control the infection caused by this device. **Method:** integrative review carried out in the LILACS and MEDLINE databases, between January 2007 and July 2012, guided by the question: What are the scientific evidences related to the strategies of healthcare team training in handling the central venous catheter for preventing and controlling the occurrence of infection related to this device? The studies were assessed and presented in a descriptive way. **Results:** the sample was composed of 11 studies. The main goal of the intervention was training the catheter insertion technique, based on the guidelines for handling the device and current evidences, having the healthcare and nursing teams as the main focus of the interventions. **Conclusion:** the standardization of infection preventive measures based on evidences and educational programs showed reduction in infection rates related to the device. **Descriptors:** Central Venous Catheterization; Continuing Education; Teaching; Hospital-Acquired Infection; In-Service Training.

RESUMO

Objetivo: sintetizar estratégias de treinamento da equipe de saúde para o manejo do cateter venoso central visando à redução e controle da infecção causada por este dispositivo. **Método:** revisão integrativa realizada nas bases de dados LILACS e MEDLINE, entre janeiro de 2007 e julho de 2012, norteadas pela questão: Quais são as evidências científicas relacionadas às estratégias de treinamento da equipe de saúde para o manuseio do cateter venoso central para a prevenção e controle da ocorrência de infecção relacionada a este dispositivo? Os estudos foram analisados e apresentados de modo descritivo. **Resultados:** onze estudos constituíram a amostra. O objetivo principal da intervenção relacionava-se ao treinamento da técnica de inserção do cateter, baseado nas diretrizes para manejo do dispositivo e evidências atuais, sendo as equipes médica e de enfermagem o principal foco das intervenções. **Conclusão:** a padronização das medidas preventivas de infecção, baseadas em evidências e programas educativos, evidenciou redução nas taxas de infecção relacionada ao dispositivo. **Descritores:** Cateterismo Venoso Central; Educação Continuada; Ensino; Infecção Hospitalar; Capacitação em Serviço.

RESUMEN

Objetivo: sintetizar estrategias de entrenamiento del equipo de salud para el manejo del catéter venoso central en busca de reducir y controlar la infección causada por este instrumento. **Método:** revisión integradora realizada en las bases de datos LILACS y MEDLINE, entre enero de 2007 y julio de 2012, guiada por la pregunta: ¿Cuáles son las evidencias científicas relacionadas a las estrategias de entrenamiento del equipo de salud para el manejo del catéter venoso central con vistas a prevenir y controlar la ocurrencia de infección relacionada a este instrumento? Los resultados fueron analizados y presentados de manera descriptiva. **Resultados:** once estudios constituyeron la muestra. El objetivo principal de la intervención se relacionaba al entrenamiento de la técnica de inserción del catéter basado en las directrices para el manejo del instrumento y evidencias actuales, siendo el equipo médico y el de enfermería el principal foco de las intervenciones. **Conclusión:** la estandarización de las medidas preventivas de infección basadas en evidencias y programas educativos demostró reducción de las tasas de infección relacionada al instrumento. **Descriptor:** Cateterismo Venoso Central; Educación Continua; Enseñanza; Infección Hospitalaria; Capacitación en Servicio.

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INTRODUCTION

Central venous catheter-related infection (CVC-RI) is seen as a serious complication—especially in intensive care units—associated with considerable morbimortality and high costs for healthcare services.¹ CVC-RI can be classified into: central venous catheter-associated bloodstream infections (CVC-BSI); clinical infection of the catheter exit site; and catheter tunnel infection. CVC-BSI occurs in patients with central venous catheter (CVC) who exhibit bacteremia and fungemia. In addition, there should be more than one positive blood culture obtained from a peripheral vein, clinical manifestations of infection with no other apparent source of bloodstream infection, and also a culture of the catheter tip with semiquantitative positive result, with the microorganism identified along the CVC being the same present in the peripheral hemoculture.²

Clinical infection of the catheter exit site is confirmed when the patients show: presence of erythema or induration at ≤ 2 cm from the catheter exit site, with the absence of concomitant bloodstream infection; and with or without purulent secretion on the site. Tunnel infection is confirmed when there is the presence of pain, erythema and/or induration at >2 cm from the exit site and the subcutaneous catheter tunnel pathway, with the absence of concomitant bloodstream infection.²

Scientific evidence suggests that the bacterial load of bloodstream infection has increased with respect to all major species of pathogens causing this complication. As a consequence, the spread of antibiotic resistance creates an additional pressure on healthcare systems, as well as the worsening health of patients affected by such infections.³

Studies show that infection is a major complication that results from the removal of the CVC.^{4,5} There are several factors that may be related to the development of infections and the number of catheter handlings is described as an important risk factor for the development of this disorder.⁶ Healthcare teams' adherence to the recommendations advocated by the guidelines/protocols for prevention and control of CVC-RI is an important preventive measure.¹ However, the literature shows that there is low compliance on the part of professionals with the incorporation of these guidelines in the clinical practice.⁷

Proper training for CVC handling may represent one of the best methods for prevention of CVC-RI.⁶ Thus, the guidelines/protocols for prevention and control of intravascular catheter-related complications recommend the implementation of well organized educational programs for training healthcare providers, since such strategies represent critical elements for the success of this goal.¹

Interventions based on educational initiatives geared towards healthcare professionals are seen as effective strategies for the prevention of CVC-associated bloodstream infections and also for reducing hospital expenses.⁸ Researchers show that inpatient units, which have written standards and active forms of training for prevention of CVC-RI, tend to have greater knowledge and better attitudes toward prevention and control measures.⁹

OBJECTIVE

- To synthesize strategies for training healthcare teams in handling central venous catheters, in order to reduce and control infections caused by this device.

METHOD

This is an integrative review that allows the synthesis of previous research with general conclusions from several different studies that have identical or related hypotheses. Thus, this study provides the reader with relevant data for a specific topic, enabling the updating of knowledge and facilitating changes in the clinical practice.¹⁰

The study was composed of the following steps: formulation of the research question; sampling; data extraction from the primary studies; assessment of the primary studies included; analysis and synthesis of the results; and presentation of the review.¹¹

With the purpose of guiding the study, the following research question was formulated: What is the scientific evidence related to the strategies for training strategies the healthcare team in order to handle central venous catheters regarding the prevention and control of the occurrence of infections related to this device? The PICO framework was used, in which: P refers to the population of the study, i.e., healthcare professionals who handle CVC; I refers to the intervention studied, namely the strategies used for the training of these professionals with respect to the catheter mentioned; C refers to the comparison with other interventions already known, even though this was not the goal of this study; and O refers to the result sought

through the intervention under study, i.e., the prevention and control of CVC-related infections.¹²

The search of publications was performed using the "Literature in the Health Sciences in Latin America and the Caribbean" (LILACS) and "Medical Literature Analysis and Retrieval System Online" (PubMed/MEDLINE) databases. The keywords "central venous catheterization" and "nursing team education" or "nursing teaching" were used for data crossing in the LILACS database. Data crossing in the PubMed/MEDLINE database was conducted using the keywords "health professional" and "central venous catheterization".

The primary studies included were those published in full from 1st January, 2007 to 31st July, 2012, in Portuguese, English, or Spanish. Studies should address the strategies for training the healthcare team in handling the CVC, focused on the prevention and control of infections related to such a device.

Editorials, letters to the editors, authors' answers, interviews with the authors, brief reports, and secondary studies were excluded from the study. In addition, primary studies that addressed strategies for training students, assessed other skills besides CVC, did not measure catheter-related infections as outcome, and addressed the CVC for hemodialysis were also excluded.

A total of 108 eligible studies were found, 98 in the PubMed/MEDLINE database and 10 in the LILACS database. Following the selection criteria, 97 studies were excluded, 75 by reading the abstracts and 22 by reading the full article. Of these studies, 35 did not address training strategies, 19 were secondary studies, 11 did not assess CVC-RI as the outcome, 10 were comments on the articles, 15 did not address the CVC, four addressed students' training, and three assessed other skills besides CVC handling. As a result, 11 studies were selected to constitute the sample of this research, all of them found in the PubMed/MEDLINE database.

A validated instrument, previously approved by the authors, was used for extracting the data from the primary studies included.¹³ This step was performed by two reviewers independently, with no divergence between them. The results were presented descriptively in order to provide elements from each primary study that enabled the assessment of evidence and understanding of the studies, thus providing support for decision making and identification of knowledge gaps for conducting further research.

In order to assist in the critical assessment of primary studies, the classification of evidence hierarchy was used according to: Level I: Evidence from systematic reviews or relevant meta-analyses of randomized controlled trials; Level II: Evidence from well designed randomized controlled clinical trials; Level III: Evidence from well designed nonrandomized clinical trials; Level IV: Evidence from well designed case-control or cohort studies; Level V: Evidence from systematic reviews of descriptive and qualitative studies; Level VI: Evidence from only descriptive or qualitative studies; and Level VII: Evidence from authors' opinions and/or reports by specialist committees.¹²

RESULTS

Regarding the authorship of the articles, it was found that the majority (n=9; 82%) had been written by physicians, either in conjunction with nurses (n=5; 45%) or individually (n=4.36%). The most frequent designs of the studies were descriptive, before and after (n=6; 54%) and training intervention for catheter handling had the medical team as the predominant target (n=10; 91%), as shown in Table 1.

Table 1. Characteristics of studies on strategies for healthcare team training focused on prevention and control of central venous catheter-related infection, with respect to the design, authorship, target team of the intervention, and the research location. Ribeirão Preto - SP, 2007-2012.

Study	Design	Authorship	Target team	Location
14	Cohort	Physicians	Medical	Mono-center GH
15	Non-described	Physicians and nurses	Medical and Nursing	Multi-center GH
16	Descriptive, before and after	Physicians and nurses	Medical	Mono-center TH
17	Descriptive, before and after	Physicians	Medical and Nursing	Mono-center GH
18	Descriptive, before and after	Physicians and nurses	Medical and Nursing	Mono-center TH
19	Descriptive, before and after	Physicians	Medical and Nursing	Mono-center TH
20	Descriptive, before and after	Physicians and nurses	Nursing	Mono-center GH
21	Cohort	N/A	Medical and Nursing	Multi-center GH
22	Cohort	Physicians	Medical and Nursing	Mono-center GH
23	Descriptive, before and after	Physicians and nurses	Medical and Nursing	Mono-center TH
24	Cohort	N/A	Medical and Nursing	Mono-center TH

Note: GH: general hospital; TH: teaching hospital

Regarding the methodological quality, six studies were classified level VI^{16-20, 23} and four level IV.^{14, 21-22, 24} In general, the studies concluded that simulation training was effective in reducing CVC-RI.¹⁴⁻²⁴ in addition, one study also associated this strategy as a positive factor for clinical training.¹⁴ Other studies stressed that team training intervention could be a model for large improvements in quality healthcare and patients' safety.^{15, 21} Furthermore, there was evidence that teaching based on simulation of CVC insertion was effective for cost-benefit, because even though it generated small increase in spending, it reduced the burden with the complications besides favoring patients directly with lower CVC-RI rates and length of hospital stay.¹⁶⁻¹⁷

Regarding the type of educational intervention, the authors demonstrated that the audiovisual strategy proved effective in controlling CVC-RI. They emphasized that the

rehabilitation and monitoring of adherence to established preventive strategies could reduce costs and healthcare provided.²⁰ Some scholars questioned the possibility of CVC-RI rates being reduced to zero in the population studied.¹⁸ Others emphasized that staff with personalized training in continuing education, observation and strengthening of practices and standards was effective in behavioral changing.²³ Still, they emphasized that a system with multiple interventions applied with evidence-based methods reduced the incidence of CVC-RI in a continuous and sustained manner and that it was a strategy of easy application that did not require technology and additional human resources.²⁴

Table 2 presents a summary of interventions and the main findings of the articles included in this integrative review.

Table 2. Summary of studies on strategies for healthcare teams training oriented to the prevention and control of central venous catheter-related infection. Ribeirão Preto-SP, 2007-2012.

Study	Intervention	Results
¹⁴	Training and simulation of CVC insertion; educational video; pre-and post-test and goals for approval, with an emphasis on preventive measures for CVC-BSI.	CVC-RI reduction from 25 to 4 infections/1000/catheter s/day
¹⁵	Educational video on patients' safety; identification of risk situations and solutions proposals; correction of failures in communication; and adoption of preventive measures for CVC-BSI.	Reduction of CVC-RI (66%), costs and length of hospital stay, and greater number of lives saved.
¹⁶	Training (classroom and teaching materials); emphasis on the recommendations of the guidelines for reducing CVC-BSI; insertion training; simulation practice; and feedback.	CVC-RI and costs reduction, compensating admission costs.
¹⁷	Insertion training classes following preventive guidelines with monitoring by nurses; daily assessment of the CVC, with mandatory practices checklist.	50% reduction of CVC-RI and reduction of annual costs from these infections.
¹⁸	Research on CVC-BSI external rates and local monitoring with comparisons and disclosure for the team; training; and CVC handling protocol.	CVC-RI reduction from 24.3 to 16.2 per 1000 patients/day.
¹⁹	Training and standardization of CVC care; educational sessions with evidence-based demonstration of CVC handling; and prevention of CVC-BSI, bedside teaching.	CVC-RI reduction (24 to 7 cases); greater adherence; and delay in CVC-RI onset.
²⁰	Standardization of CVC hub dressing with educational video and bedside checklist (hub care);and emergency cart for CVC care.	Global reduction in CVC-RI rates; and increased adherence to the new protocol.
²¹	Implementing CVC-RI preventive evidence and adherence report; checklist (CVC insertion); daily CVC assessment; and disclosure of CVC-BSI rates.	CVC-RI reduction from 683 to 404 cases; increased adherence to the practices.
²²	Literature review and new guideline on CVC-BSI preventive practices with daily goals to ensure adherence; application of checklist for CVC insertion; and CVC monitoring.	CVC-RI reduction, 2.6 to 2.4/1000 catheters/day; and 100% adherence.
²³	Report on CVC-BSI rates; questionnaire on physicians' knowledge; CVC handling with CVC-BSI preventive measures checklist.	CVC-RI reduction; and increased adherence to practices proposed.
²⁴	Training (CVC-SI preventive measures); checklist for strict monitoring; and educational sessions (insertion/maintenance).	CVC-RI reduction, 6.7 to 2.4/1000 catheters/day.

Note: CVC = central venous catheter; CVC-RI = central venous catheter-associated bloodstream infections.

When the different types of educational strategies were assessed, it was found that the main goal of the intervention in four studies was related to training the CVC insertion technique.¹⁴⁻¹⁷ In other three studies, the main goal was training the team for handling the catheter on the basis of the guidelines.¹⁸⁻²⁰ Other four studies focused on both goals.²¹⁻²⁴ The guidelines most frequently used were: handwashing technique; use of maximal sterile barrier; antisepsis with chlorhexidine; avoiding femoral region puncture; daily assessment of the need of CVC permanence; and removal if there was no indication for permanence.

All the studies assessed showed that there was a reduction in the CVC-RI rates after the implementation of the educational intervention. Studies that assessed the cost-benefit of expenses with such interventions showed that there was financial benefit to the hospital, be it the reduction of spending on CVC-RI, the length of stay of the patient in the unit, or the number of lives saved with successful preventive measures.¹⁵⁻¹⁷ Still, there is evidence that after the educational intervention there was greater adherence of

professionals in complying with the practices for preventing CVC-RI.¹⁹⁻²³

DISCUSSION

The present study described the effectiveness of various types of educational programs on the prevention and control of intravascular catheter-related infection. The emphasis was the control and prevention of CVC-BSI, encompassing measures from the time of insertion, maintenance and removal of the catheter through different activities performed by the healthcare team.

Conducting research aiming to enhance the link between theory and practice in healthcare services is a challenge oriented to provide healthcare able to ensure patients' safety.²⁵ Authors show that interdisciplinary educational approaches are successful in reducing CVC-RI rates. These approaches are related to the standardization of insertion procedures and the maintenance of these devices.^{1, 26}

Another study highlighted the complexity of implementing standards as measures for prevention and control of CVC-RI. This is an

important strategy to improve the dynamic structure of healthcare and patients' safety. It allows uniformity in health actions with evidence-based healthcare and the relevant involvement of the whole team.²⁷

Considering the importance of actions involving all health professionals, it is recommended to implement protocols and multidisciplinary guidelines focusing on techniques for insertion and maintenance of CVC. This is a preventive measure for infections related to these devices, and the control of risk factors has a major impact in reducing these infections.²⁸

The articles assessed in this study used a variety of measures to prevent and control CVC-BSI.¹⁴⁻²⁴ According to the guidelines for prevention of these infections, the main measures were: handwashing; maximal sterile barrier precautions; skin preparation; dressing scheme used; daily assessment of the catheter insertion site; safe practice of injections administration; sterile technique during catheter insertion and handling; use of ultrasound to guide the insertion; avoiding puncturing the femoral vein; and the removal of the access as quickly as possible when there is no further use indication.¹

Training actions demonstrate a direct effect on increasing knowledge and skills of professionals as well as enhancing the qualification and motivation of the teams.²⁹ The effect of these actions are also influenced by the trajectory of individual learning in addition to scientific knowledge.³⁰ However, professionals' adherence to measures for prevention and control of infections demonstrates the relationship with continuing educational activities, as well as the importance of supervision and development of ways to reapproach strategies over time.²⁷

However, this review article presented limitations. Due to the selection criteria, the identification of some related studies may not have occurred. Another limitation was the restriction of search to only two electronic databases, even though the database with the highest number of indexations in the healthcare field had been included. Regarding the character of the educational programs, they provided an interactive environment and a more active learning on the part of the participants in these trainings. There were changes in the form of providing new knowledge without, however, pointing out models of assessment instruments with validity and reliability for these professionals' adherence to CVC handling.

CONCLUSION

The studies available showed that training strategies, based on many educational programs models, reduce the occurrence of catheter-related infections. There are preventive measures addressing the various technical skills related to both the insertion and the maintenance of the intravascular device for the success of these strategies.

In short, the characteristics that should be highlighted are the standardization of prevention and control measures based on current evidence. At the same time, continuing educational programs should be emphasized in order to encourage the adherence of health professionals to the measures proposed by these programs.

It is emphasized that the implementation of these strategies has a positive global cost-benefit for health institutions and the involvement of the entire healthcare team is essential. There is a need for additional studies grounded in educational programs with evidence-based recommendations for the training of healthcare professionals in the prevention and control of intravascular catheter-related complications.

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