Nursing care in the prevention of infections related to cerebrospinal fluid shunting: an integrative review

Cuidados de enfermagem na prevenção de infecções relacionadas à derivação do líquido cefalorraquidiano: revisão integrativa

Cuidados de enfermagem na prevenção de infecções relacionadas com a derivação do líquido cefalorraquidiano: revisão integrativa

**ABSTRACT**

**Objective:** to gather scientific evidence on nursing care in the prevention of infections related to the use of external ventricular or lumbar shunts in patients admitted to intensive care units.  

**Method:** an integrative review was conducted using the bibliographic databases MEDLINE, Web of Science, CINAHL, and LILACS, with specific descriptors. Inclusion criteria comprised primary research articles published in English, Portuguese, or Spanish, focusing on nursing care in the prevention of infections related to the use of external ventricular or lumbar shunts in patients admitted to intensive care units, published in the last 5 years. Exclusion criteria included review articles, experience or case reports, articles that did not meet the study objective, duplicate articles, theses, and dissertations. **Results:** a total of 11 articles were included in the review. The main findings regarding infection prevention highlighted the importance of hand hygiene, implementation of aseptic techniques, use of occlusive dressings with chlorhexidine, assessment of cerebrospinal fluid characteristics, and evaluation of inflammatory signs. **Conclusion:** the effective measures identified in this study should be implemented to prevent infection risks and complications in the patient's health condition.

**Descriptors:** Nursing Care; Catheter-Related Infections; Infection Control; Intensive Care Units; Cerebrospinal Fluid Shunts.

**RESUMO**

**Objetivo:** buscar evidências científicas sobre a assistência de enfermagem na prevenção de infecções relacionadas ao uso de derivação ventricular externa ou derivação lombar externa em pacientes internados em unidades de terapia intensiva. **Método:** revisão integrativa realizada nas bases bibliográficas MEDLINE, Web of Science, CINAHL e LILACS, utilizando descritores específicos. Critérios de inclusão: pesquisas primárias publicadas em inglês, português ou espanhol; com a temática de assistência de enfermagem na prevenção de infecções relacionadas ao uso de derivação ventricular externa ou derivação lombar externa em pacientes internados em unidades de terapia intensiva; publicadas nos últimos 5 anos. Critérios de exclusão: artigos de revisão; relatos de experiência ou de caso; artigos que não atendessem ao objetivo do estudo; artigos duplicados; teses e dissertações. **Resultados:** foram encontrados 11 artigos que compuseram a revisão. Dentre os principais achados para prevenir infecções, destacam-se: higienização das mãos, implementação de técnicas assépticas, uso de curativos oclusivos com clorexidina, verificação das características do líquido cefalorraquidiano e avaliação de sinais flogísticos. **Conclusão:** as medidas efetivas encontradas neste estudo devem ser implementadas para evitar riscos de infecção e complicações do quadro de saúde do paciente.

**Descritores:** Cuidados de Enfermagem; Infecções Relacionadas a Cateter; Controle de Infecções; Unidades de Terapia Intensiva; Derivações do Líquido Cefalorraquidiano.
RESUMEN

**Objetivo:** recopilar evidencia científica sobre la atención de enfermería en la prevención de infecciones relacionadas con el uso de derivaciones ventriculares o lumbares externas en pacientes ingresados en unidades de cuidados intensivos. **Método:** revisión integrativa utilizando las bases bibliográficas MEDLINE, Web of Science, CINAHL y LILACS, con descriptores específicos. Los criterios de inclusión comprendieron artículos de investigación publicados en inglés, portugués o español, centrados en la atención de enfermería en la prevención de infecciones relacionadas con el uso de derivaciones ventriculares o lumbares externas en pacientes ingresados en unidades de cuidados intensivos, publicados en los últimos 5 años. Los criterios de exclusión incluyeron artículos de revisión, informes de experiencia o casos, artículos que no cumplieran con el objetivo del estudio, artículos duplicados, tesis y disertaciones. **Resultados:** se incluyeron un total de 11 artículos en la revisión. Los principales hallazgos en cuanto a la prevención de infecciones destacaron la importancia de la higiene de manos, la implementación de técnicas asepsias, el uso de apósitos oclusivos con clorhexidina, la evaluación de características del líquido cefalorraquídeo y la evaluación de signos inflamatorios. **Conclusion:** las medidas efectivas identificadas en este estudio deben implementarse para prevenir infecciones y complicaciones en la salud de los pacientes.

**Descriptores:** Atención de Enfermería; Infecciones Relacionadas con Catéteres; Control de Infecciones; Unidades de Cuidados Intensivos; Derivaciones del Líquido Cefalorraquídeo.

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INTRODUCTION

The incidence of infections in critical care settings varies significantly across different studies and geographic regions, but it has witnessed a concerning increase in recent years. This escalation can be attributed to the improved sensitivity, speed, and accuracy of diagnoses. In order to prevent these infections, continuous vigilance is imperative. In 2017, a staggering 54% of patients in Intensive Care Units (ICUs) worldwide were suspected or confirmed to have an infection, while 70% of them were receiving at least one antibiotic (either prophylactic or therapeutic). Additionally, the in-hospital mortality rate stood at 30%.

Given that the ICU is an environment of critical importance, the risk of infection among patients in this setting demands particular attention, especially for those with critical neurological conditions. Such patients often exhibit deficiencies in one or more bodily systems and necessitate constant monitoring by a multidisciplinary team in relation to their health status. Consequently, depending on the severity and clinical circumstances, the utilization of invasive devices becomes essential for the treatment, evaluation, and recovery of these patients.
Among the invasive devices employed, the external ventricular shunt (EVD) and external lumbar shunt (ELD) drains are frequently inserted in patients with critical neurological conditions. Due to their invasive nature, aseptic management is essential to prevent complications, particularly infections.4

EVD entails a neurosurgical procedure wherein a drain is inserted into the skull to monitor intracranial pressure (ICP) and facilitate cerebrospinal fluid (CSF) drainage. It is typically performed to alleviate elevated ICP resulting from conditions such as hydrocephalus, intracranial hemorrhage, bacterial meningitis, tumors, and other injuries.5-7

The incidence rate of infection associated with external ventricular catheter usage is 11 per 1,000 days of catheter use, and 9 to 20% of patients with CSF drainage through a ventricular catheter develop catheter-associated infections, depending on the assessment criteria employed.8 These infections primarily arise during the surgical insertion procedure, routine care activities like drain manipulation, or they may originate from a retrograde infection of the distal end of the drain, with the latter being the most common cause of EVD-associated infections.9

In contrast, the ELD is inserted into the lumbar spinal canal.10 This device shares some indications with the EVD but is primarily employed as an adjunct to cranial procedures. The use of ELD in non-neurological domains primarily encompasses CSF drainage to reduce intradural pressure and prevent spinal cord ischemia during and after complex aortic aneurysm surgeries.11-12

Hence, despite recognizing the necessity and significance of utilizing invasive devices such as EVD and ELD, discussions regarding the management of associated infections have been approached with considerable apprehension. Among the risks associated with the placement and maintenance of these catheters, the occurrence of CSF infections is of particular concern, with reported rates ranging from 2% to 45%.13-14

In certain cases, the use of these devices can result in ventriculitis and meningitis, whereby concurrent extracranial infections and catheter insertion outside the operating room emerge as the primary risk factors for such infections.14-16

In this context, it is crucial to reaffirm the significance of this study in contributing to the understanding of evidence-based care and nursing interventions aimed at minimizing the aforementioned risks. The findings of this study can provide valuable insights for the nursing
team in their efforts to prevent infections associated with the utilization of external ventricular shunt or external lumbar shunt in hospitalized patients within intensive care units.

**OBJECTIVE**

To gather scientific evidence on nursing care in the prevention of infections related to the use of external ventricular or lumbar shunts in patients admitted to intensive care units.

**METHOD**

An integrative literature review was conducted between February and March 2022. This type of research enables a systematic and comprehensive exploration of primary studies, with the primary objective of identifying knowledge gaps pertaining to the topic at hand. The writing and development of the entire study adhered to the recommendations outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to ensure the study's quality.17

To formulate the research question, "How does nursing care occur in the prevention of infections related to patients with external ventricular shunt or external lumbar shunt admitted to intensive care units?", the PICo acronym structure was utilized. In this structure, "P" represents the population of interest, "I" signifies the intervention or phenomenon of interest, and "Co" indicates the context of the investigation. Consequently, this study adopted the following structure: P - Patients admitted to intensive care units utilizing external ventricular shunt or external lumbar shunt; I - Nursing assistance in the prevention of infections associated with the use of external ventricular shunt or external lumbar shunt; and Co - Intensive care units.

The following inclusion criteria were applied to select articles for this study: they should represent primary research published within the past 5 years and be available in English, Portuguese, or Spanish. Additionally, the articles should specifically address the nursing care aspect of preventing infections associated with the use of external ventricular shunt or lumbar shunt in patients hospitalized in intensive care units. Review articles, experience reports or case reports, articles that did not align with the study's purpose, duplicate articles, theses, and dissertations were considered as exclusion criteria.

The search for relevant publications was conducted in the following databases: Medical Literature Analysis and Retrieval System Online (MEDLINE via PubMed), Web of Science,
Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Latin American and Caribbean Literature in Science of Health (LILACS via VHL).

The search process in the databases was carried out in two stages. In the first stage, a more specific and sensitive search strategy was used in each database. The Boolean operator "AND" was used to restrict the search and obtain the intersection of sets of documents that had all the terms combined. In the second stage, a more comprehensive search strategy was used, using the Boolean operator "OR" to add more information to the scope of the investigation. The following descriptors were used during the search process: "Nursing Care", "Intensive Care Units", "Catheter-related Infections", "Cerebrospinal Fluid Shunts", and "Infection Control". The search strategies adopted in the databases were as follows: "Nursing Care" AND "Intensive Care Units" AND "Cross Infection" AND "Catheter-related Infections" AND "External Ventricular Drain" AND "External Lumbar Drain" AND "Prevention and Control", "Nursing Care" AND "Intensive Care Units" AND "Cross Infection" AND "External Ventricular Drain", "Intensive Care Units" AND "Cross Infection" AND "External Ventricular Drain", "Preventing Infections In External Ventricular Drains" AND "External Ventricular Drain Infections" OR "Lumbar Drain Infections".

After conducting the search in the designated databases, the articles were initially screened based on their titles and abstracts. Duplicate articles and those that did not directly address the topic of interest were excluded during this initial screening process. The remaining studies were then reviewed in their entirety, and further exclusions were made based on the previously established inclusion criteria.

Data analysis

Data extraction from the selected studies was conducted using a specific instrument adapted from the Joanna Briggs Institute (JBI) guidelines. Relevant information, including author(s), year of publication, title, and country of origin of the studies, was collected (see Figure 2). Additionally, excerpts that described the main results of interest for this review were recorded (see Figure 3). The evaluation of the studies regarding the level of evidence was performed based on the classification provided by the Oxford Centre for Evidence-Based Medicine.
It is important to note that, as this study is a literature review, it did not involve direct data collection from human subjects. Therefore, obtaining formal ethical approval from a Research Ethics Committee was not necessary.

**RESULTS**

The initial database search yielded a total of 685 articles. After removing 122 duplicate articles, the titles and abstracts of the remaining 563 articles were examined. Among these, 508 articles were excluded as they did not pertain to the topic under investigation. Consequently, 55 articles were selected for a thorough reading. After a comprehensive assessment, 44 articles were further excluded as they did not fulfill the research objective, resulting in 11 articles for the final analysis (Figure 1).

**Figure 1.** Flowchart of the study selection process according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA). Recife, PE, Brazil, 2022

Based on the findings, it was found that most studies were published in 2017 (n=3), 2018 (n=3), and 2021 (n=3), with cohort studies as the most prevalent methodological design (n=8). The United States emerged as the most prolific country in terms of publications on the subject (n=6) (Figure 2).
<table>
<thead>
<tr>
<th>Code</th>
<th>Year</th>
<th>Authors</th>
<th>Title</th>
<th>Study design</th>
<th>Country</th>
<th>Level of evidence</th>
</tr>
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<tbody>
<tr>
<td>A120</td>
<td>2021</td>
<td>Hong B et al.</td>
<td>Effect of a bundle approach on external ventricular drain-related infection</td>
<td>Prospective cohort</td>
<td>Germany</td>
<td>2B</td>
</tr>
<tr>
<td>A221</td>
<td>2021</td>
<td>Walek KW et al.</td>
<td>Decreasing External Ventricular Drain Infection Rates in the Neurocritical Care Unit: 12-Year Longitudinal Experience at a Single Institution</td>
<td>Prospective cohort</td>
<td>United States</td>
<td>2B</td>
</tr>
<tr>
<td>A322</td>
<td>2021</td>
<td>Zakaria J et al</td>
<td>Effectiveness of a Standardized External Ventricular Drain Placement Protocol for Infection Control</td>
<td>Retrospective cohort</td>
<td>United States</td>
<td>2B</td>
</tr>
<tr>
<td>A423</td>
<td>2020</td>
<td>Talibi SS et al.</td>
<td>The implementation of an external ventricular drain care bundle to reduce infection rates</td>
<td>Retrospective cohort</td>
<td>United States</td>
<td>2B</td>
</tr>
<tr>
<td>A524</td>
<td>2019</td>
<td>Yaney E et al</td>
<td>Implementation of external ventricular drain insertion and maintenance protocol checklist to reduce infections in the pediatric population</td>
<td>Intervention</td>
<td>United States</td>
<td>2B</td>
</tr>
<tr>
<td>A625</td>
<td>2018</td>
<td>Champey J et al.</td>
<td>Strategies to reduce external ventricular drain–related infections: a multicenter retrospective study</td>
<td>Retrospective cohort</td>
<td>France</td>
<td>2B</td>
</tr>
<tr>
<td>A726</td>
<td>2018</td>
<td>Lewis A et al.</td>
<td>Results of a quality improvement initiative reassessing an institutional lumbar drain infection prevention protocol</td>
<td>Prospective cohort</td>
<td>United States</td>
<td>2B</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Authors</td>
<td>Title</td>
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<tr>
<td>A827</td>
<td>2018</td>
<td>Roethlisberger M et al.</td>
<td>Effectiveness of a Chlorhexidine Dressing on Silver-coated External Ventricular Drain–associated Colonization and Infection: A Prospective Single-blinded Randomized Controlled Clinical Trial</td>
<td></td>
<td></td>
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<tr>
<td>A928</td>
<td>2017</td>
<td>Tsioutis C et al.</td>
<td>Clinical characteristics, microbiology and outcomes of external ventricular drainage-associated infections: The importance of active treatment</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Figure 2.** Characterization of studies included in the review according to year of publication, authorship, title, study design, and country of origin. Recife, PE, Brazil, 2022

During the analysis of the selected studies, three distinct categories for evaluation were formulated: 1) appropriate catheter handling, 2) dressing change and application, and 3) infection surveillance (Figure 3).
<table>
<thead>
<tr>
<th>Category</th>
<th>Nursing Care</th>
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</table>
| Appropriate catheter handling  | ● Perform hand hygiene before initiating any procedure\(^{22,23,25}\)  
● Adhere to aseptic technique protocols in all procedures\(^{22,23,25,26,30}\)  
● Utilize sterile gloves\(^{22,23}\)  
● Maintain a closed system strictly\(^{28,29,35}\)                                                                                           |
| Dressing change and application| ● Use alcoholic chlorhexidine\(^{22,23,25,29}\)  
● Apply occlusive dressing\(^{22,23}\)  
● Check for CSF leakage during each dressing change\(^{24}\)                                                                                  |
| Infection surveillance         | ● Verify CSF flow and characteristics\(^{22,24,27,28}\)  
● Monitor for signs of inflammation at the catheter insertion site\(^{24,30}\)                                                                  |

Figure 3. Key nursing interventions and care practices in the prevention of infections in patients utilizing external ventricular shunts or external lumbar shunts. Recife, PE, Brazil, 2022.

**DISCUSSION**

The findings of this review underscore the significance of providing risk-free nursing care to patients utilizing EVD and ELD. Several key precautions were identified, including proper hand hygiene, adherence to aseptic techniques, assessment of inflammatory signs at the catheter insertion site, monitoring the characteristics of drained fluid, verification of leaks, assessment of cerebrospinal fluid flow, maintenance of occlusive dressings, and the use of alcoholic chlorhexidine for asepsis at the insertion site. These precautions align with previous studies that highlight the importance of comprehensive and systematic management throughout the procedure and post-insertion phase, with the aim of reducing infection rates\(^{14,31}\).

It is important to emphasize that, in clinical practice, there can sometimes be resistance to adopting these recommended practices, which can have detrimental effects on patient health outcomes\(^{32}\).

One of the studies indicated that employing a chlorhexidine dressing at the insertion site and minimizing routine CSF collection in the EVD reservoir were associated with a reduction in infections\(^{33}\). A similar result was demonstrated in another study that employed a similar technique, also demonstrating a significantly lower incidence of EVD-related infections\(^{34}\).

During the dressing renewal process, healthcare professionals have the opportunity to assess the presence or absence of infection signs at the catheter insertion site, following their respective service routines and utilizing specific materials. A multicenter study conducted in three different ICUs did not observe a statistically significant difference between changing occlusive dressings every two days and every four days. The study findings suggested that the
The optimal duration for dressing changes may vary based on factors such as the type of material used and the patient's overall health condition.\textsuperscript{25} 

The inspection of CSF leakage at the insertion site holds paramount importance as it serves multiple purposes, including identifying signs of infection, evaluating the characteristics of the fluid, and verifying the patency of the catheter.\textsuperscript{35} Reduced drainage fluid can lead to hydrocephalus remodeling caused by leaks, clamping, obstructions, or other complications. Furthermore, it is crucial to emphasize the significance of proper patient mobilization in bed, meticulous management of the drainage system and EVD catheter, continuous monitoring of CSF, appropriate collection of CSF samples, and careful administration of medications.\textsuperscript{36-37}

The frequency of CSF monitoring in external and lumbar ventricular drains can vary among different healthcare institutions. While some institutions collect CSF daily, others do so only when clinical signs or symptoms suggestive of infection arise, such as a decline in neurological status, fever, headache, leukocytosis, or neck stiffness.\textsuperscript{38-39} It is important to note that while CSF collection is necessary, it should be performed cautiously, as excessive collections can be a risk factor for infection. Therefore, it is crucial to implement specific protocols and ensure that personnel are properly trained to minimize excessive catheter handling, thus reducing the risk of infection.\textsuperscript{40-41} Moreover, infections associated with lumbar and external ventricular shunts have a significant impact on clinical morbidity and healthcare costs. These findings emphasize the urgent need for improved infection prevention measures in the handling of these devices.\textsuperscript{42}

Given the critical nature of patient care, it is imperative that nursing professionals provide qualified and evidence-based assistance in the management of catheters and their corresponding systems. Nurses have a crucial role in ensuring the proper positioning, sterility, and integrity of the collection system for patients who use EVD, as well as protecting the patient during activities such as transportation and bed baths. It is essential to adhere to validated protocols and scientific evidence to prevent clamping and inappropriate manipulation of the catheter.\textsuperscript{36} Furthermore, continuous evaluation and surveillance of the patient's clinical condition and the functioning of the devices are of utmost importance to prevent potential complications.\textsuperscript{37}

The limitations of this study primarily relate to the predetermined publication timeframe and the inclusion of studies published only in English, Portuguese, and Spanish. This selection criterion may have resulted in the exclusion of relevant research on the subject. This limitation
became apparent during the database search process, as it was observed that several studies with substantial interventions were published prior to the timeframe covered by this review. It is worth noting that investigations into the role of nursing in the care of patients with EVD or ELD are still in their early stages, indicating the necessity for further research in this area.

CONCLUSION

The study emphasized the significance of proper management, adherence to aseptic techniques during dressing changes, and continuous monitoring of devices and their functionality to mitigate the risk of infection and complications in patients with EVD and ELD. These findings underscore the importance of implementing specific protocols, bundles, checklists, and other tools within healthcare settings to enhance the effectiveness and control of treatment and recovery processes. The results of this study can serve as a valuable foundation for informed decision-making in infection management, thereby reducing the associated impacts and ensuring a safer environment for healthcare professionals working in intensive care units.

CONTRIBUTIONS

The authors of this study made equal contributions to the design of the research project, data collection, analysis, and discussion. They also collectively participated in the writing process, critically reviewed the content, and provided intellectual input throughout the study. All authors approved the final version of the study before submission.

CONFLICT OF INTERESTS

Nothing to declare.

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