

***Hemodialysis catheter-related infection: systematic review****Infecção relacionada aos cateteres de hemodiálise: revisão sistemática**Infección relacionada con el catéter de hemodiálisis: revisión sistemática*Fabiana Rezer¹, Wladimir Rodrigues Faustino¹, Bruno Felipe Oliveira Pereira³¹ Centro Universitário São Camilo, Nursing Department, São Paulo, São Paulo, Brazil.² Faculdade do Norte de Mato Grosso, Nursing Department, Guarantã do Norte, Mato Grosso, Brazil.**ABSTRACT**

Objective: To list the main hemodialysis catheters that trigger infection. **Method:** systematic literature review, descriptive with quantitative approach, in which searches were performed in the databases: SCIELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Health Sciences Literature), BDENF (Nursing Database), MEDLINE (Online Medical Literature Search and Analysis System), IBECs (Spanish Bibliographic Index in Health Sciences), COCHRANE LIBRARY and CINAHL (Cumulative Index to Nursing and Allied Health Literature), data collection was held between April and July 2019. **Results:** 11 articles were selected after applying the inclusion/exclusion criteria. The studies showed that the main triggering catheters of infection are the provisional catheters, of which stand out the double lumen. **Conclusion:** Due to the high use in health services, vigilance in the use of temporary catheters, especially double lumen, is recommended.

Descriptors: Catheter-related infections; Renal dialysis; Incidence.

RESUMO

Objetivo: relacionar os principais cateteres de hemodiálise desencadeadores de infecção. **Método:** revisão sistemática da literatura, descritiva com abordagem quantitativa, no qual foram realizadas buscas nas bases de dados: SCIELO (Scientific Electronic Library Online), LILACS (Literatura Latino-americana e do Caribe em Ciências da Saúde), BDENF (Base de dados da Enfermagem), MEDLINE (Sistema Online de Busca e Análise de Literatura Médica), IBECs (Índice Bibliográfico Español en Ciencias de la Salud), COCHRANE LIBRARY e CINAHL (Cumulative Index to Nursing and Allied Health Literature), a coleta de dados foi realizada entre abril e julho de 2019. **Resultados:** foram selecionados 11 artigos após aplicação dos critérios de inclusão/exclusão da pesquisa. Os resultados demonstraram que os principais cateteres desencadeadores de infecção são os provisórios, deles se destacam o duplo lúmen. **Conclusão:** Com isso foi possível observar que o índice de infecção impacta diretamente no tempo de internação do paciente, custos e tratamento.

Descritores: Infecções relacionadas a cateter; Diálise renal; Incidência.

RESUMÉN

Objetivo: relacionar los principales factores desencadenantes infección del catéter de hemodiálisis. **Método:** revisión sistemática de la literatura, descriptiva con enfoque cuantitativo, en la que se realizaron búsquedas en las bases de datos: SCIELO (Biblioteca electrónica científica en línea), LILACS (Literatura latinoamericana y caribeña de ciencias de la salud), BDENF (Base de datos de Enfermería), MEDLINE (Sistema de Búsqueda y Análisis de Literatura Médica en línea) e IBECs (Índice Bibliográfico Español en Ciencias de la Salud), BIBLIOTECA DE COCHRANE y CINAHL (Índice Acumulativo de Literatura de Enfermería y Salud Aliada), la recolección de datos fue celebrada entre abril y julio de 2019. **Resultados:** se seleccionaron 11 artículos después de aplicar los criterios de inclusión/exclusión. Las pesquisas mostraron que los principales catéteres desencadenantes de infección son los catéteres provisionales, de los cuales se destaca la doble luz. **Conclusión:** Debido al alto uso en los servicios de salud, se recomienda la vigilancia en el uso de catéteres temporales, especialmente los catéteres de doble luz.

Descriptorios: Infecciones relacionadas con el catéter; Diálisis renal; Incidencia.

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INTRODUCTION

Hemodialysis appeared in Brazil in May 1949. Since then, patients have enjoyed a new treatment, which has been improved over the years. This procedure filters, purifies and eliminates health-damaging blood substances, replacing almost all kidney functions. The goal is to eliminate toxins that accumulate in the circulation because the kidney cannot properly filter or eliminate them.¹

Hemodialysis is performed by a machine in which the patient's blood is extracorporeally circulated through a venous access, which may be a catheter or an arteriovenous fistula, and is then driven by a pump to the dialysis filter (dialyzer). In the dialyzer, blood is exposed to the dialysate solution through a semipermeable membrane that removes excess fluid and toxins and returns clean blood to the patient via vascular access.²

Therapies can be performed weekly (3 times a week), or in critical cases full time. The number of hemodialysis units in Brazil has been growing over the years and consequently the index of hemodialysis patients also, in 2015, the number reached 111,303 patients. Among the most prevalent underlying pathologies associated with chronic kidney disease (CKD) and the need for hemodialysis were systemic arterial hypertension (SAH) and Diabetes Mellitus (DM), this procedure covers 10% of the world population.³

The catheters used for hemodialysis are the provisional catheters: double lumen and triple lumen central venous catheter (CVC) and shiley catheter; the permanent catheter: permcath. These catheters are intravascular

Infecção relacionada a cateter de hemodiálise access pathways in a large vein: jugular; subclavian or femoral.⁴

Hemodialysis catheters bring several benefits to patients, but they can also pose risks to patients, such as infection, which may develop at the insertion site or spread into the bloodstream. Approximately 60% of infections are considered to be related to some type of intravascular catheter.⁵

The development of infections can be associated with several risk factors, ranging from choosing the type of catheter to be used to its removal. Thus, it is essential to perform an analysis of these devices and verify if any particular type may be predisposing to the development of infection. It is estimated that in Brazil hemodialysis catheter infection can present a mortality of up to 75%.⁴

Therefore, according to the problem pointed out, the objective of this research was to analyze the main catheters that trigger infection in patients on hemodialysis through a mapping of published studies.

METHOD

This is a systematic review that gathers the best available scientific evidence, enabling methodological instruments of evidence-based practice (EBP), integrating and grouping results of a particular theme from primary studies conducted in independent places, times and populations. It is considered the most rational way to elucidate, organize and evaluate scientific publications.⁶⁻⁸

To this end, the guiding question was structured through the PICO strategy, thus raising the following question: which hemodialysis

catheters are most predisposing to developing infection?

Table 1: PICO strategy.

Abbreviation	Description	Guiding question
P	Population	Hemodialysis Patients
I	Intervention	Hemodialysis Catheterization
C	Comparison	Different catheters
O	Outcome	Infection Development

The development of the systematic review took place between February and May 2019, having as databases searched: SCIELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Health Sciences Literature), BDNF (Database of Nursing), MEDLINE (Online Medical Literature Search and Analysis System), and IBECS (Spanish Bibliographic Index in Health Sciences), COCHRANE LIBRARY and CINAHL (Cumulative Index to Nursing and Allied Health Literature), determining the sample of this stage of research. The research strategy was performed through the use of controlled descriptors - Health Sciences Descriptors (DeCS); hemodialysis; catheter; infection; and terms in MeSH: hemodialysis; catheter; infection; bloodstream infection.

Then, the inclusion and exclusion criteria of the research were defined as the purpose of guiding the literature search and improving the accuracy of the results associated with the guiding question. The following were established: full articles; originals; published between 2008 and 2018; articles in Portuguese, English and Spanish. Exclusion criteria: monographs, dissertations and theses; cards; editorials; case studies; repeated articles in the databases; articles that did not address hemodialysis catheter infection.

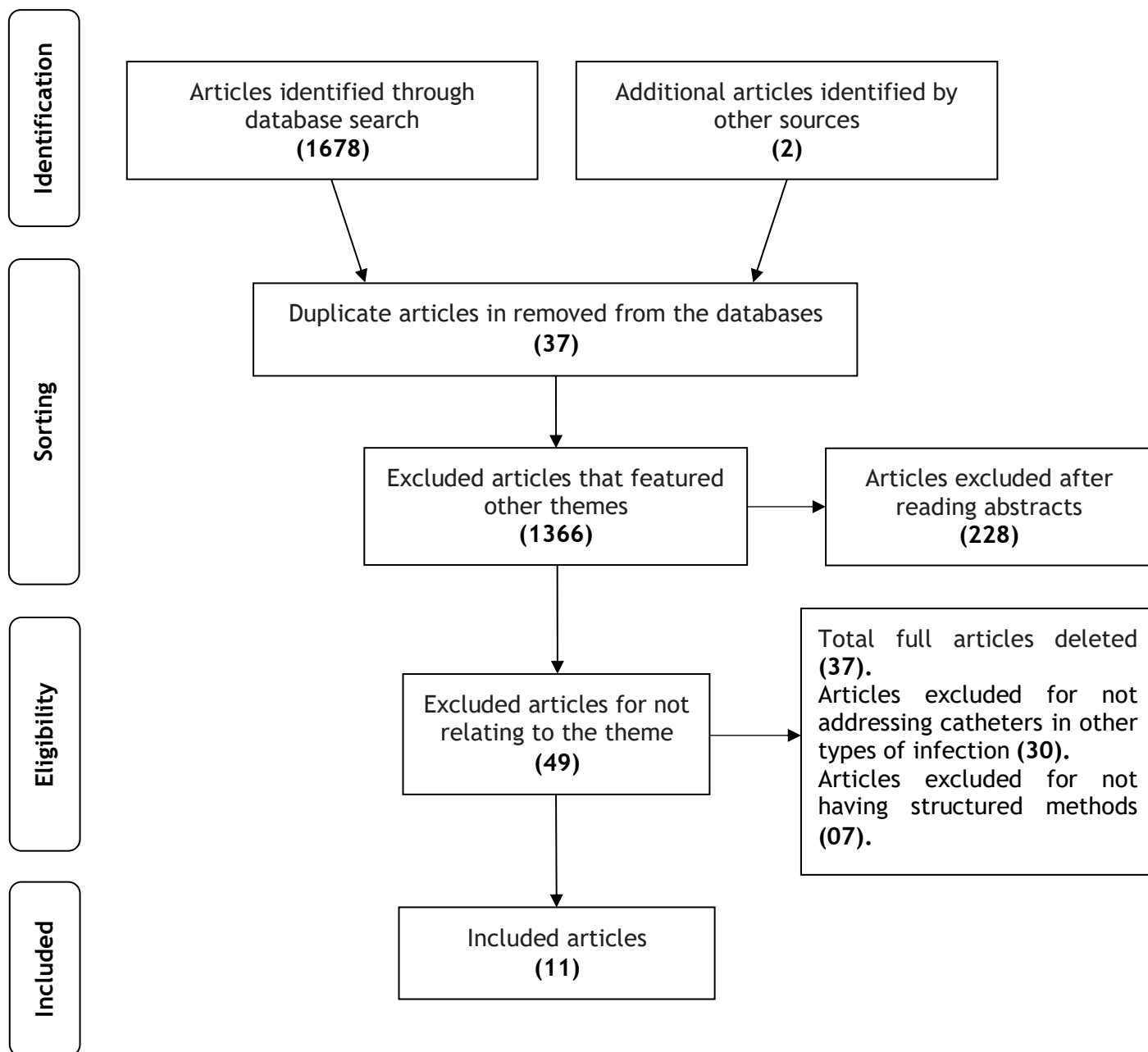
The temporal cut aimed to identify articles published in the last 10 years. In order to expand the electronic search and make it more complete, a manual search of documents was performed, as well as a review of the bibliographic references of previously included studies in order to expand the database, as well as check possible articles not added.

After selection, an analysis of the titles and abstracts of the articles was performed by two reviewers independently, applying the inclusion and exclusion criteria of the research; Subsequently, the full reading for selection was performed by an author, using the same eligibility criteria. For this study were considered as variables: previously developed project; country of study development; year of publication; summary; goal; method; indicator validation criteria; source of data; quality dimension and level of education of the authors, these dimensions suggest the quality of the primary articles.

The search resulted in 1678 articles, of which 1667 were excluded; After pre-selection in the databases, articles were selected for analysis, as follows: 37 articles were repeated in the databases; 228 were removed after reading the abstracts; so 49 articles were selected for eligibility; After reading, 37 articles were still

removed, namely: 30 articles for not providing information about the hemodialysis catheter infection, and 07 articles for not having a

structured methodology. Result in 11 articles in final sample.



Flowchart 1: Process of selecting articles in databases according to the PRISMA.

RESULTS

In the period studied, 1678 studies were found, of which eleven articles were used according to the application of the pre-established inclusion

criteria: 45% (05) in English; 10% (01) in Spanish and 45% (05) in Portuguese.

These 11 studies analyzed presented different analyzes regarding the hemodialysis

catheter infection. To facilitate the analysis of the results, table 02 was elaborated with

increasing numbering by year of publication, year, objective and type of catheter approached.

Table 02: Articles selected according to year of publication; title; aim; method and main results.

Article	Year	Aim	Main results
A01	2008	To identify the infection index, etiological agent, infectious complications and length of stay of the double lumen catheter in the same period in alternate years.	Of the 80 patients undergoing hemodialysis treatment, 21% had a catheter and three years after 186 patients 10.7% had catheter therapy. There was a 9.4% decrease in bloodstream infections in the latter.
A02	2009	Follow the hemodialysis catheter insertion for 30 days to determine the frequency of infection, causative microorganisms and predisposing factors that contribute to these infections.	Of the 57 patients (26 male) who received central catheters, 11 patients developed proven catheter-related infection by blood culture. The causative microorganisms were sensitive to empirically used antibiotics.
A03	2010	To evaluate the incidence and risk factors for bloodstream infection in patients with double lumen central venous catheter for hemodialysis.	Of the 156 patients who were included in the study, 94 developed infection. Patients with an infectious condition were 50% more at risk of death.
A04	2011	Which vascular access infections represent the primary cause of morbidity and mortality in these patients?	We monitored 1545 patients/month. The incidence of events at both centers was 8.7 cases per 100 patient-months. The rate of infectious events was 9.1 for venous artery fistula and 20.6 for permanent catheter in the hospital setting.
A05	2015	To identify risk factors associated with hemodialysis temporary catheter infection in dialysis patients in a teaching hospital.	48.8% had catheter-related infection, 65% were male, 65% were 60 years of age or older and 88% were admitted to an intensive care unit.
A06	2018	To measure the incidence of infection in a short-stay central venous catheter for hemodialysis and to identify associated risk factors.	69 patients, who used 88 catheters. The incidence of infection was 9.1%, and the risk factors were length of stay and catheter insertion into the left femoral vein.
A07	2018	Report a series of 12 cases of translumbar catheter implantation for hemodialysis, its implantation technique, patency and complications.	All 12 triple lumen catheter were successfully deployed and use; 41.6% of patients had catheter-related infection after 98 ± 72.1 days (6-201 days), but there was no need for removal; and the patency was 315.5 catheter days (65-631 days).
A08	2018	To analyze complications and outcomes of non-tunneled catheters used for vascular access in a dialysis unit.	Fifty-four patients with a mean age of 43.7 ± 15.8 years were 69. Thrombosis occluding catheters was the most common complication and occurred in 58% of catheters leading to catheter malfunction, followed by infections in 18.8 %.
A09	2017	Determine if differential management of catheter-related bloodstream infections could explain results.	Over a 2-year period, a total of 365 patients 823 central venous catheter insertions.
A10	2018	Verify bloodstream infection in immigrants.	329 patients; A total of 101 infections occurred, with a rate of 0.84 infections per 1000 catheter days.

A11	2018	<p>To measure the incidence of infection in a short-stay central venous catheter for hemodialysis and to identify the associated risk factors.</p>	<p>Among the sociodemographic and clinical characteristics, results indicate that patients older than 60 years have a higher risk of developing infection than other patients, just as those who report alcoholism and presence of comorbidities such as hypertension and diabetes.</p>
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It is important to highlight that of the 11 selected articles, 07 of them were published in the last four years (2015 - 2018), which shows a current literature on the subject.

Regarding the methodological aspect, most articles used the quantitative approach, in

relation to the type of study, are mostly descriptive, retrospective and prospective. In order to associate the catheters, table 03 was elaborated showing the types and incidence of infection.

Table 3: Displays the category according to catheter type; Articles belonging to infection category and index.

Category	Articles	Total of catheters	Infection rate
Temporary catheter: double lumen	03	N=840 (100%)	N=198 (24%)
	04		
	09		
	01		
	11		
Temporary catheter: triple lumen	02	N=329 (100%)	N=101 (30.6%)
	06		
Polyurethane temporary catheter	05	N=129 (100%)	N=63 (48.8%)
Permanent catheter	08	N=2368 (100%)	N=433 (18%)
	10		
Translombor catheter	07	N=12 (100%)	N=5 (41.6%)

DISCUSSION

The bloodstream infection is still a theme that presents various difficulties in its control. It is important to emphasize that patients needing hemodialysis also needs a catheter to perform that, however, these catheters have a chance to develop infections in insertion site and systemic infections, which the incidence may be directly associated with the type and catheter that this

patient uses.⁹ So, it is important to list what are the catheters that present more infection.

In this research, it was possible to evidence that most articles reported on the infection in the provisional double lumen CVC. It is noteworthy that in this research 24% of the patients studied by the articles identified in the search developed catheter-related infection. Nevertheless, this type of catheter is a reliable option for patients requiring dialysis, but many

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factors favor the development of infection, including: the tip of the catheter; skin surrounding the puncture site and contamination during catheter use.¹⁰

One of the important factors associated with the development of bloodstream infection in hemodialysis patients is the type of catheter they use.

The insertion site is also an important factor that influences the infection. It is estimated that the catheter inserted in the jugular vein significantly increases the infection rate, as well as higher risks of mechanical complications.¹⁰

According to data presented by the National Healthcare Safety Network, the rate of infection in the bloodstream, the catheter with the highest infection, was the short-stay CVC (with 27.1/100 patient days), followed by the long-stay catheter with 4.11. corroborate this study, in which the catheters that developed the most infection were the short-stay central venous accesses, among them the double-lumen and triple-lumen catheters stand out.

Short-term CVC are the largest associated with bloodstream infection.⁵ The double lumen catheter (DLC) is a type of access that allows hemodialysis to be performed. In this study, a significant number of patients with CDL infection were evidenced, which corroborates with the current literature, that the incidence has a variability between 3.2 - 40.4 events per thousand catheter days, with a high mortality rate, this is due to the lower number of lumens, the lower the number of lumens the greater the use of the pathways, increasing the manipulation

Infecção relacionada a cateter de hemodiálise and consequently the infection rate. in the catheter-associated bloodstream.¹¹

The DLC is considered the first access route for hemodialysis, in which about 80% of patients using hemodialysis therapy began their treatment with this type of catheter.¹² From this it is assumed that the high infection rate associated with this catheter is explained by the high utilization rate.

About 60% of bloodstream infections are associated with an intravascular catheter, causing direct impacts on the patient's length of stay and mortality, however, it is suggested that these catheters are indispensable for the treatment of hemodialysis patients and should be used/manipulated more rigorously to reduce high rates of infection.⁵

Due to the lack of clinical conditions, some patients are unable to access hemodialysis, however the translumbar hemodialysis catheter is considered a safe and effective option for those patients with limited venous access but has complication rates such as infection and thrombosis.

Even though it is a safe option, special care should be taken to avoid infection, especially associated with the translumbar catheter. Second, 41.6% of the catheters had some kind of infection with phlogistic signs present (heat, discharge, local pain and smoking), catheter-associated bloodstream infection (CABI) with positive blood culture and insertion ostium and surrounding skin infection.^{13,14}

According to ANVISA, some measures are needed to prevent catheter infections in general, health education of the professionals involved, hand hygiene, optimal choice of insertion site,

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aseptic sterile maximum safety barrier measures, alcohol preparation or chlorhexidine, use of Personal Protective Equipment (PPE's), daily inspection through checklist, ideal dressing coverings, in order to prevent infections.

In a CVC study highlighted simple measures such as hand hygiene and daily cleaning of the CVC insertion site with 2% chlorhexidine during one year of intervention, it was possible to achieve a 58% reduction in infection rates in a hospital ICU Chicago and with the same performance in another hospital in the same city, the same intervention provided a 99% reduction in infections.¹⁵

As a CVC access route, we highlight the triple lumen for patients in need and hemodialysis, which has an exclusive route for medication, however, the lowest number of lumens is always indicated in order to avoid excessive manipulation and consequently possible infections, in this same study. It was also evidenced that there was no increase in catheter infection rate with greater number of lumens.¹⁶⁻¹⁸

It is important and noteworthy that basic care before and after catheter manipulation is essential to prevent general infections as mentioned above.

The study has potential relevance in the clinical care practice of doctors and nurses who work with CVC. It presents as relevance: a systematic review that will facilitate the choice of a hemodialysis catheter with lower risk of infection; facilitate clinical decision-making of

Infecção relacionada a cateter de hemodiálise patients who need hemodialysis catheters; suggestions for improving the care/maintenance of such catheters by reducing the rate of infections.

Regarding the limitations of the study, it is noteworthy that the puncture sites were not evaluated, which could impact the incidence of catheter infection. Furthermore, preventive measures were not reported, encouraging the search for new research that highlights infection prevention measures with the available scientific evidence on the subject.

CONCLUSION

Our study shows that the rate of infection associated with the hemodialysis catheter is more frequent in the temporary catheter. This allows us to direct attention to this type of catheter, as well as promote strategies to prevent infection associated with it.

Among the articles found, the majority of articles were related to Double Lumen catheter infection, requiring specific actions and care associated with this type of catheter, which is indispensable in hemodialysis patients, besides being the preferred route in beginners of this therapy.

Thus, it is encouraged to adopt actions that minimize infections, since infections directly impact the patient's health, treatment, length of stay and quality of hemodialysis care.

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