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Review

Evidence summary of prevention strategies for catheter-related infections among cancer patients with home parenteral nutrition

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ABSTRACT

Objective: To provide a comprehensive summary of evidence on prevention strategies for catheter-related infections among cancer patients with home parenteral nutrition.
Methods: A systematic literature search was conducted for identifying prevention strategies for catheter-related infections among cancer patients with home parenteral nutrition, including clinical decisions, guidelines, best practices, expert consensus, evidence summaries, and systematic reviews. The search period includes publications from January 2000 to April 2024.
Results: Seven articles were included in the review, comprising four guidelines, one expert consensus, and two systematic reviews. This resulted in the identification of five evidence themes and 33 best evidence statements, addressing safety and monitoring, team and education training, hand hygiene and aseptic techniques, catheter and exit site selection, and catheter care and protection.
Conclusions: This evidence summary identifies the prevention of catheter-related infections in home parenteral nutrition, and offers valuable resources for clinical application and guidance for preventing infections among cancer patients receiving home parenteral nutrition.

Introduction

Home parenteral nutrition (HPN) is a primary therapeutic approach for patients with benign diseases leading to intestinal failure and is increasingly being employed for cancer patients.[1] In some Western countries, the estimated rates of HPN use range from 6.61 to 79 per million residents per year, with these figures steadily rising.[2–4] As an optimal alternative to prolonged hospitalization, judicious use of HPN can enhance patients' nutritional status, extend their survival, improve their quality of life, and offer long-term cost-effectiveness benefits.[5,6]

The primary route for HPN infusion is through a central venous access device (CVAD). However, long-term use of CVADs is associated with the risk of catheter-related infections (CRI). CRI in HPN patients can include local infections at the catheter exit site, infusion port, or subcutaneous catheter tunnel, as well as systemic infections such as catheter-related bloodstream infections (CRBSI).[7] The incidence rate of CRI in HPN patients can be as high as 1.35 per 1000 catheter-days.[3] CRI not only increases the medical burden required to salvage the catheter but can also lead to the loss of vascular access and even jeopardize patients' lives.[3,8]

Therefore, effective CRI prevention strategies are fundamental to achieving optimal care quality for HPN patients and improving patient outcomes. This study aimed to provide a comprehensive summary of strategies for preventing catheter-related infections in home parenteral nutrition, aiming to offer scientific guidance to patients in China receiving HPN treatment to mitigate the risk of CRI.

Methods

This study employed the PIPOST method to identify evidence-based issues and utilized the "6S" model for literature search.[9,10]

Problem formulation

In this study, the research question was formulated using the PIPOST model.[9] "P" (population): HPN patients; "I" (intervention): strategies for preventing CRI; "P" (professionals): nutrition support teams, patients, and their caregivers; "O" (outcomes): incidence of CRI and adherence to prevention strategies; "S" (setting): home and community hospitals; "T" (types

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of evidence): clinical decisions, recommended practices, clinical guidelines, evidence summaries, expert consensus, systematic reviews.

Search strategy

Following the "6S" classification model for evidence-based resources,[10] a comprehensive search was conducted in UpToDate, British Medical Journal (BMJ) Best Practice, Guidelines International Network, Scottish Intercollegiate Guidelines Network, Joanna Briggs Institute, Cochrane Library, Medline, PubMed, China National Knowledge Infrastructure (CNKI), and Wanfang Data. Specialized databases were also searched, including the American Society for Parenteral and Enteral Nutrition (ASPEN), European Society of Parenteral and Enteral Nutrition (ESPEN), Australasian Society for Parenteral and Enteral Nutrition (AuSPEN), The Parenteral and Enteral Nutrition Society of Asia (PENSA), British Association for Parenteral and Enteral Nutrition (BAPEN), and Chinese Society for Parenteral and Enteral Nutrition (CSPEN). The search timeframe was from January 2000 to April 2024.

Each database uses the following keyword strings: "home parenteral nutrition" or "home total parenteral nutrition", "Catheterization*" or "Catheters" or "Vascular Access Devices", "Complication*" or "Infection" or "sepsis" or "bacteremia" or "fungemia", and "prevention" or "control" or "management" or "therapy" or "treatment" or "care" or "nursing care". Additionally, guidelines and nutrition specialist websites focused on "home parenteral nutrition" or "home total parenteral nutrition". Full search terms and sample of searching steps at PubMed was shown in Appendix 1.

Evidence inclusion and exclusion criteria

For a study to be included, the study population had to be patients undergoing home parenteral nutrition therapy; the research topic had to focus on prevention strategies for catheter-related infections in home parenteral nutrition; and the types of literature had to include clinical decision-making, clinical practice guidelines, evidence summaries, expert consensus, or systematic reviews. The literature could be in either Chinese or English. Studies were excluded if they had been previously published in more than one source; if the full text could not be obtained; if the literature primarily interpreted existing guidelines without presenting new research or evidence; if older versions of guidelines had been subsequently updated; or if the research did not pass the quality assessment process.

Literature quality assessment criteria

To ensure the reliability and validity of the included studies, this study applied rigorous quality assessment criteria using recognized tools specific to each type of literature. Clinical guidelines were evaluated for quality using the Appraisal of Guidelines for Research and Evaluation II (AGREE II) system.[11] Systematic reviews were assessed using the Assessment of Multiple Systematic Reviews (AMSTAR).[12] Expert consensus was evaluated using the quality assessment tool from the Australia JBI Evidence-Based Healthcare Center (2016 version).[13] Two authors (YZ, PZ) independently assessed the quality of the literature according to the respective quality assessment standards. In cases of disagreement, a third researcher was involved in the discussion to reach a consensus.

Evidence synthesis and grading

Two authors (YZ, PZ) extracted and integrated evidence from the included literature and independently assigned evidence grades. After discussion within the evidence-based team, the final evidence was determined. The JBI evidence pre-grading and evidence recommendation level system (2014 version) was used to categorize evidence into levels 1 to 5.[14]

Results

Findings of literature screening

A preliminary search produced 1016 articles. After a systematic literature search and screening process, as shown in Fig. 1, 7 articles met the inclusion criteria. There are comprising 4 clinical guidelines,[7,15–17] 1 expert consensus,[18] and 2 systematic reviews.[2,19] The basic characteristics of the included literature are summarized in Table 1.

Findings of literature quality evaluation

The quality evaluation results of the guidelines are presented in Table 2. This evidence summary only includes one expert consensus,[18] and all items were evaluated as "yes," thus this expert consensus was included. For the two systematic reviews[2,19] included in this study, aside from item 4, which received a "no" evaluation, all other items were assessed as "yes." Consequently, both reviews were included.

Findings of evidence synthesis and grading

A total of five key themes were identified, encompassing safety and monitoring, team and education training, hand hygiene and aseptic techniques, catheter and exit site selection, and catheter care and protection. This led to the identification of 33 pieces of best evidence, as outlined in Table 3.

Discussion

Providing a safe treatment environment for cancer patients with HPN

HPN is a complex therapeutic modality that, if not prepared and managed appropriately, can lead to severe complications. Experienced Nutrition Support Teams (NST) play a pivotal role in enhancing the safety of long-term HPN therapy, promoting intestinal rehabilitation, and mitigating the risk of complications.[7,15] The responsibilities of NST encompass the entire spectrum of HPN therapy. Prior to commencing HPN treatment, NST assesses medical suitability, the household environment, and the educational levels or learning abilities of patients and caregivers to ensure the safety of the treatment environment. This includes considerations such as sanitary water supply, electrical power availability, refrigerator storage conditions, telephone communication, and storage space for clean materials.[15,20] Throughout HPN treatment, NST implements systematic, comprehensive, and sustained monitoring measures to ensure the safety and efficacy of HPN therapy. Furthermore, NST educates patients on self-monitoring, enabling the timely identification and prevention of potential complications.[7,18] Thus, for patients undergoing HPN treatment, a secure treatment environment includes not only an appropriate physical setting but also the capacity of patients and caregivers to execute HPN care procedures and gain guidance and support from a professional multidisciplinary team.

The significance of secure vascular access for successful HPN management

The type of central venous catheter (CVC), the number of lumens, and the placement location can all potentially lead to CRI in HPN patients.[8] Currently, there is no conclusive evidence from randomized controlled trials regarding the impact of catheter type on CRI in HPN patients, and the published observational study results are inconsistent.[2,8,21,22] Guidelines established by ASPEN analyzed nine studies comparing the relationship between CRBSI and CVC type, concluding that tunneled CVCs have lower infection rates and a longer time to the first infection compared to infusion ports or peripherally inserted central venous catheters (PICCs).[16] Therefore, for patients requiring long-term HPN, tunneled CVCs are considered preferable.

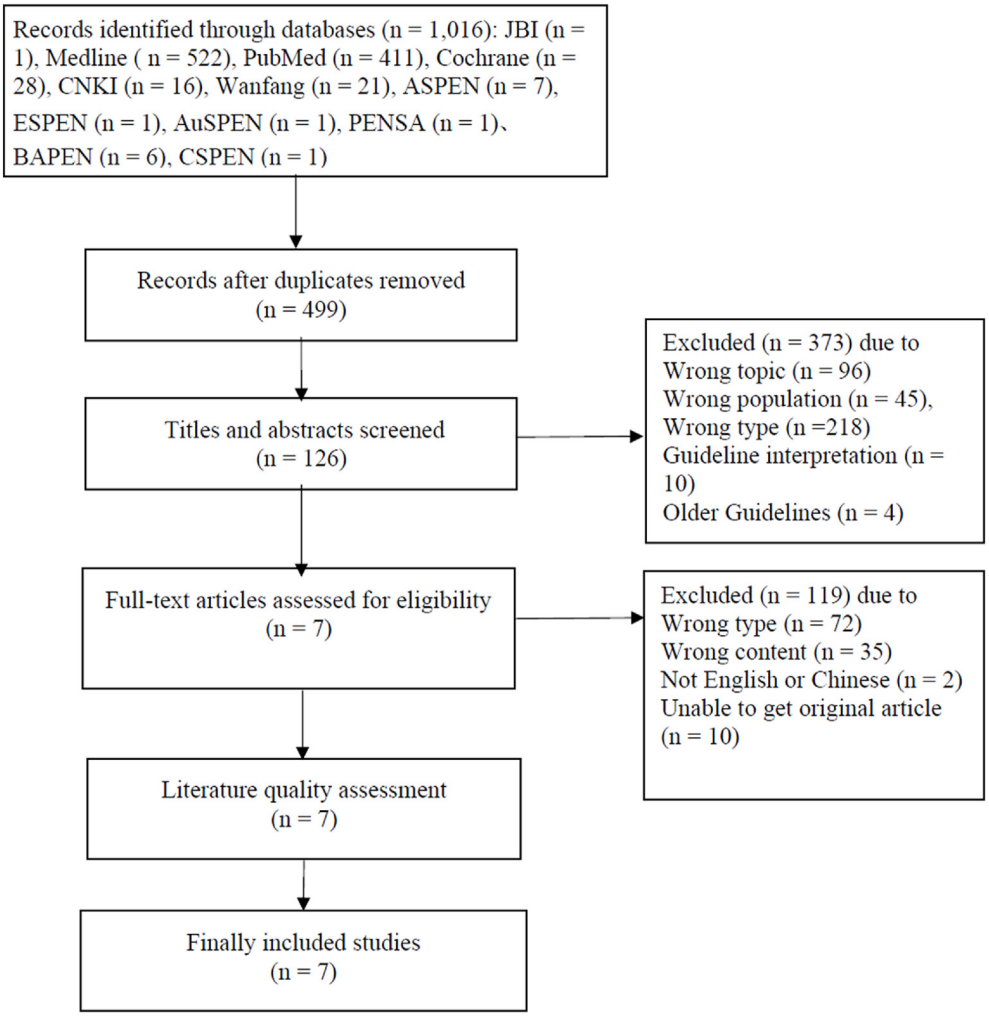

Fig. 1. Flow diagram of literature search.

Table 1
Basic characteristics of included studies.

Author	Literature source	Literature type	Publication date	Literature title
Pironi et al.[15]	ESPEN	Guideline	2023	ESPEN practical guideline: Home parenteral nutrition
Cuerda et al.[7]	ESPEN	Guideline	2021	ESPEN practical guideline: Clinical nutrition in chronic intestinal failure
Kovacevich et al.[16]	ASPEN	Guideline	2019	American society for parenteral and enteral nutrition guidelines for the selection and care of central venous access devices for adult home parenteral nutrition administration.
Gillanders et al.[17]	AuSPEN	Guideline	2008	BIFA guidelines
CSPEN[18]	CNKI	Expert consensus	2019	Chinese expert consensus on adult home parenteral nutrition
Wouters et al.[19]	PubMed	Systematic review	2022	Use of catheter lock solutions in patients receiving home parenteral nutrition: A systematic review and individual-patient data meta-analysis.
Mateo-Lobo et al.[2]	PubMed	Systematic review	2019	Infectious complications in home parenteral nutrition: A systematic review and meta-analysis comparing peripherally-inserted central catheters with other central catheters.

ESPEN, European Society of Parenteral and Enteral Nutrition; ASPEN, American Society for Parenteral and Enteral Nutrition; AuSPEN, Australasian Society for Parenteral and Enteral Nutrition; CNKI, China National Knowledge Infrastructure; CSPEN, Chinese Society for Parenteral and Enteral Nutrition; BIFA, British intestinal failure alliance.

Additionally, experts from ESPEN note that the exit location of PICCs can restrict the mobility of one side of the patient's arm, making self-care challenging and increasing the risk of PICC dislodgement.[7,15] Hence, evidence underscores the importance of selecting the catheter type for HPN patients based on treatment duration, the level of care, patient flexibility, and other potential comorbidities that may lead to catheter-related complications.[17,19] Furthermore, the number of lumens is also related to the incidence of CRI. Studies have shown that patients with single-lumen CVCs have significantly lower CRBSI rates than those with multi-lumen CVCs.[23–25] Fewer lumens reduce the number of manipulations required for flushing and medication administration before and after HPN therapy, thereby reducing the chances of contamination, lowering costs, and necessitating less maintenance.

Table 2
Quality evaluation results of included guidelines.

Study	Standardized scores in various domains (%)						≥ 60%	≤ 30%	Quality
	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence			
Pironi et al.[15]	100.0	94.4	91.7	88.9	81.2	100.0	6	0	A
Cuerda et al.[7]	100.0	86.1	81.3	77.8	73.0	79.2	6	0	A
Kovacevich et al.[16]	100.0	41.7	76.0	88.9	68.8	100.0	5	0	B
Gillanders et al.[17]	100.0	72.7	97.9	72.2	29.2	92.0	5	1	B

Table 3
Results of evidence synthesis and grading.

Themes of evidence	Evidence content	Level of evidence
Safety and monitoring	1. The suitability of the home care environment should be assessed and approved by the HPN nursing team before starting HPN, wherever possible.[7,14]	5
	2. For a safe HPN program, the patient and/or caregiver must understand and perform the required procedures for the safe administration of therapy.[14]	5
	3. The NST for HPN/CIF should provide patients and caregivers with written information about recognizing and managing HPN-related complications, including contact details for an NST member available 24 hours a day for emergencies.[14]	5
	4. The NST should disseminate clear protocols to hospital emergency departments regarding the identification, examination, and primary management of HPN-related complications.[14]	5
	5. Patients or their family members should be educated in self-monitoring, engaging with healthcare personnel, and promptly informing NST members of any abnormalities.[17]	5
	6. Patients receiving HPN should be monitored at regular intervals to review the indications, efficacy, and risks of the treatment.[7,14,17]	5
Team and education training	7. HPN patients should be cared for by an NST with skills and experience in CIF and HPN management.[7,14,16]	3
	8. The NST should consist of experts in HPN provision, including a physician, specialist nurses (including those skilled in catheter, wound, and stoma care), dietitians, pharmacists, social workers, psychologists, and practitioners with expertise in CVC placement. Surgeons with expertise in intestinal failure should also be available for consultation.[14,16,17]	3
	9. A formal individualized HPN training program for the patient and/or caregiver and/or home care nurses should be conducted. This includes training in catheter care, pump use, and the prevention, recognition, and management of complications. Training can occur in an in-patient setting or at the patient's home.[7,14,16,17]	5
	10. HPN patients are encouraged to join non-profit groups that provide HPN education, support, and networking opportunities.[7]	3
Hand hygiene and aseptic techniques	11. Strict aseptic technique for the care of home CVAD should be maintained.[7,14,17]	1
	12. Hand antisepsis and aseptic non-touch technique should be used when changing the dressing on CVADs.[14]	1
	13. Hand decontamination, either by washing hands with soap and water or preferably with alcohol-based hand rubs, should be performed immediately before and after accessing or dressing a CVAD.[7,14,17]	1
	14. Avoid catheter care immediately after changing or emptying ostomy appliances.[7]	3
	15. HPN requires the establishment of a parenteral nutrition compounding area within the home environment,[7,15] and the compounding of parenteral nutrition solutions should be conducted according to strict aseptic techniques and procedures.[16,17]	5
Catheter and exit site selection	16. The choice of CVAD type and location of the exit site should be made by a multidisciplinary HPN team, along with an experienced specialist and the patient.[7,14,16]	5
	17. The exit site of the catheter should be easily visualized and accessible for patients performing self-care.[7,14]	5
	18. Tunneled CVADs or totally implanted CVADs should be used for long-term HPN. PICCs can be used if the duration of HPN is estimated to be less than six months.[7,14–17]	3
	19. If a PICC is used for HPN, no suture device should be used to reduce the risk of infection.[14]	2
	20. Select a high-quality catheter with the fewest number of lumens.[7,15–17]	3
Catheter care and protection	21. Home catheter maintenance should be performed at least once a week. HPN lines should be changed every 24 hours, and the infusion port needle heads should be replaced at least once a week.[7,14]	1
	22. A 0.5%–2% alcoholic chlorhexidine solution should be used during dressing changes and skin antisepsis. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol should be used as an alternative.[14]	1
	23. Either a sterile gauze or a sterile, transparent, semipermeable dressing should be used to cover the CVAD exit site.[14]	1
	24. When transparent dressings are used on tunneled or implanted CVAD exit sites, they should be replaced no more than once per week (unless the dressing is soiled or loose).[14]	1
	25. Efforts should be made to minimize routine blood sampling from a CVAD.[14]	3
	26. In multi-lumen catheters, a dedicated lumen should be used for PN infusion.[14]	3
	27. The CVAD or CVAD site should not be submerged unprotected in water.[14]	1
	28. Sodium chloride 0.9% instead of heparin should be used to lock long-term CVADs.[14]	2
	29. Catheter locking with taurolidine may be used to prevent CRI.[7,14,18]	1
	30. Locking the catheter with 70% ethanol is not recommended for CRI prevention due to the associated risks of systemic toxicity, catheter occlusion, and catheter damage.[7]	3
	31. The following measures are not recommended for CRI prevention: Use of in-line filters, routine replacement of catheters, antibiotic prophylaxis, and use of heparin lock.[7]	5
	32. The creation of an arterio-venous fistula may be suggested to prevent CRI in carefully selected patients.[7]	4
	33. For patients who repeatedly present with CRI, re-education of the patient and/or caregiver and/or use of an anti-microbial catheter lock is recommended.[7,15]	3

HPN, home parenteral nutrition; NST, nutrition support team; CIF, chronic intestinal failure; CVC, central venous catheter; CVAD, central venous access device; PICCs, peripherally inserted central venous catheters; CRI, catheter-related infections.

Educating and training patients and informal caregivers to enhance their competence in HPN

Managing HPN in the home care setting is significantly different from that in hospitalized patients, with stricter requirements for patients and informal caregivers. Various guidelines strongly recommend providing HPN education and training to establish independent self-management skills in patients and caregivers, thereby improving compliance with HPN therapy.[7,15,17,18] In recent years, HPN training has primarily been conducted in patients' homes. Bond et al. first reported no difference in the rate of CRBSI between patients receiving HPN training at home and those trained in the hospital, but home-based training significantly reduces hospitalization time.[26] Furthermore, the study shows that patients receiving HPN care from professional HPN personnel, such as home care nurses, have a lower incidence and recurrence rate of CRBSI compared to patients managing HPN on their own or by informal caregivers, which is consistent with the results of Reber et al. Educational interventions come in various forms, including one-on-one counseling, feedback methods, training manuals, computer-assisted learning, and interactive demonstrations (videos, CD/DVD, and internet-based education).[27] Educational materials should be customized as much as possible for each patient. Given the widespread use of smartphones and tablets, short videos demonstrating common nursing skills are crucial for HPN patients. Pierik et al. and Smith et al. found that video demonstrations can reduce the CRBSI incidence in HPN patients and enhance their ability to seek professional assistance for problem-solving.[28,29]

However, Emery et al. pointed out that factors related to healthcare personnel, including hand hygiene compliance and variations in handwashing techniques, might hinder the effectiveness of video education interventions.[30] Hence, educating and training patients and their caregivers on hand hygiene and aseptic techniques is essential. Zingg's team found that evidence-based catheter care, guided by healthcare personnel's cognition, supplemented with bedside education, can significantly reduce the incidence of CRBSI.[31] Although the increase in nurse hand hygiene compliance is limited, educational interventions can significantly improve the rate of correct hand disinfection procedures by nurses. Internationally, it is widely recognized that joining national nonprofit support and educational organizations can improve outcomes for HPN patients. A case-control study showed that, compared to the control group, the CRI incidence rate in 49 HPN patients supported by the OLEY Foundation was significantly lower.[32] HPN peer support groups are active in European countries and Australia and New Zealand.[7] However, in our country, there are currently no corresponding resources and information support organizations. Medical scholars and society should be urged to establish nonprofit organizations to provide professional information and emotional support for this group.

Strict hand hygiene and aseptic procedures are fundamental in preventing catheter-related infections

Most CRIs in HPN patients are caused by human skin flora.[21] Therefore, maintaining proper hand hygiene and implementing aseptic procedures are critical in preventing CRI. The British Intestinal Failure Alliance (BIFA) emphasizes key principles for HPN care and the management of CVADs, including identifying critical sites (such as the catheter hub, the end of the giving set, syringe tip, and the skin surrounding the exit site), ensuring no contact with these critical sites during procedures, and using alcohol for hand sanitization if there is any contact with non-sterile items or any risk of contamination.[33] The Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) recommend alcohol-based hand rubs containing 60%–95% alcohol as the optimal method for hand sanitization.[34] Alcohol-based hand sanitizers offer superior microbial clearance compared to other handwashing solutions and reduce the duration of handwashing while minimizing skin irritation.

Additionally, the availability of bedside alcohol solutions can enhance healthcare personnel's compliance with hand hygiene.[15] To date, there is no well-defined optimal handwashing frequency for home care.[7] ESPEN guidelines suggest avoiding immediate catheter care after changing or emptying ostomy bags, which is crucial.[7,15] Studies have shown that ostomies/wounds are predictive factors for CRI in HPN patients.[24,35] This could be due to ostomies or wounds providing a direct pathway between gastrointestinal bacteria and the skin, with rich microbiota in the intestinal fluid potentially increasing the catheter's exposure risk. In addition to providing education and training on hand hygiene and aseptic procedures, NST should regularly assess and evaluate patients and their caregivers to improve the standardization and compliance of their care procedures. Furthermore, NST can offer patients and caregivers record templates, encouraging them to maintain a diary to document the frequency and timing of hand hygiene, as well as any changes in their complaints and catheter conditions, for timely identification of complications and necessary interventions.

Prophylactic application of Antimicrobial Lock Therapy

For cancer patients receiving HPN treatment, a strict catheter care protocol is indispensable. However, relying solely on catheter care may not be sufficient to effectively prevent CRBSI. Many countries have adopted Antimicrobial Lock Therapy (ALT) to prevent colonization of the catheter lumen microbiota, further reducing the risk of infection. The antimicrobial agents commonly used in ALT include antibiotics, ethanol, and taurolidine.[8,19,36] Wang et al. found that the use of ALT for catheter locking can reduce CRI by 68%.[37] The preventive efficacy, ranked from best to worst, was observed with taurolidine, ethanol, antibiotics, and urokinase. This implies that in high-risk populations, the prophylactic use of ALT is an effective measure. This approach allows for the containment of high-concentration drugs within the catheter without direct exposure of the entire systemic circulation to these high-concentration medications. However, due to concerns about bacterial resistance, experts do not recommend the prophylactic use of antibiotic and antifungal lock solutions in HPN patients.[7] Additionally, a 70% ethanol lock may cause catheter occlusion, catheter damage, as well as systemic toxicity, such as headache, fatigue, dizziness, nausea, and abnormal liver function and thus, its use is not advised.[7,8,38] The ESPEN 2023 updated guidelines no longer recommend the use of heparin in HPN patients, as heparin promotes the formation of intraluminal biofilms and heparin flushing does not prolong the patency time of the CVAD compared to normal saline.[15] Furthermore, the use of heparin flush solutions increases costs and may lead to heparin-induced thrombocytopenia.[16]

Compared to heparin, normal saline, and antibiotics, taurolidine has broad-spectrum antibacterial and antifungal activity, effectively inhibits biofilm formation, and does not lead to bacterial resistance or adverse reactions, proving to be the most effective catheter lock solution for preventing CRBSI in HPN patients.[8,19,36] The use of long-term indwelling CVC ALT is more common abroad. Although the “Evidence-Based Guidelines for Clinical Practice of Children's Intravenous Therapy” published in China in 2021 recommend the use of taurolidine, ethanol, antibiotics, and urokinase lock solutions to prevent CVC-related bloodstream infections, the prevalence of ALT application in China is not high.[39] This might be due to the low prevalence of HPN treatment in China, and in the hospital environment, healthcare personnel believe that strict compliance with hand hygiene, aseptic procedures, and catheter care protocols are sufficient to prevent CVC-related infections. However, HPN patients require long-term implantation of CVAD, and in most cases, non-professionals perform operations and care in non-medical environments, which may pose more infection risks. Therefore, for HPN patients at high risk of CRI, the prophylactic use of ALT may be a more appropriate option.

Limitations

This evidence summary has several limitations that must be acknowledged. First, the literature search, although comprehensive, may have

missed relevant studies published outside the selected databases or in languages other than English and Chinese, potentially introducing publication bias. Additionally, the heterogeneity among the included studies regarding patient populations, intervention methods, and outcome measures could affect the generalizability of the findings. The reliance on guidelines and expert consensus, which may vary in their methodological rigor, also poses a limitation. Moreover, the lack of randomized controlled trials (RCTs) comparing different catheter types and infection prevention strategies limits the ability to draw definitive conclusions about the most effective approaches. Finally, variations in healthcare systems and clinical practices between countries could impact the applicability of the evidence to different settings, particularly between Western countries and China. These limitations suggest that while the review provides valuable insights into catheter-related infection prevention in home parenteral nutrition, further high-quality, context-specific research is necessary to refine and validate these strategies.

Conclusions

This evidence summary offers best available evidence regarding strategies for preventing CRI among cancer patients with HPN. The findings have significant implications for cancer patients, caregivers, and home care nurses in preventing HPN CRI. Although HPN has been adopted relatively late in China, the ongoing socioeconomic development, improvements in community healthcare systems, evolving healthcare policies, and the expansion of "Internet Plus Nursing" services indicate that HPN treatment for intestinal failure patients in China is becoming increasingly common.

There is an ongoing need to develop and refine HPN practices tailored to the specific healthcare landscape in China. This is crucial for delivering optimal care to HPN patients and reducing the occurrence of complications. It is important to note that the evidence included in this study primarily derives from English-language literature. Given the differences in clinical contexts between China and other countries, it is recommended that the application of this evidence be complemented by the clinical decision-making of multidisciplinary teams, considerations of the home environment of patients, the educational level of nursing staff, and their capacity for continuous learning. This evidence summary can be judiciously applied and translated into effective clinical practices, facilitating the development of personalized strategies for preventing CRI among cancer patients with HPN.

Ethics statement

Not required.

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CRediT authorship contribution statement

Yu Zhong: Conceptualization, Formal analysis, Writing original draft. **Xiaoqin Chen, Yu Zhong**: Conceptualization, Formal analysis, Writing original draft. **Shuai He, Ping Zhang**: Conceptualization, Methodology, Writing – Review & Editing. **Yu Zhong**, **Yingchun Zeng:** Conceptualization, Formal analysis, Writing Review & Editing. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of competing interest

The authors declare no conflict of interest. The corresponding author, Dr. Yingchun Zeng, is an editorial board member of *Asia-Pacific Journal of Oncology Nursing*. The article was subject to the journal's standard procedures, with peer review handled independently of Dr. Zeng and their research groups.

Data availability statement

The data that support the findings of this review are available on request from the first author.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2024.100570.

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