Rusali Niraula Timsina
Amy Ballan
Steluta Alexandra Biaudet

Diaconia University of Applied Sciences
Nursing Degree
Bachelor's Degree program
Thesis, 2024

PERIPHERAL CANNULA INFECTION

Nursing Assessment

ABSTRACT

Rusali Niraula Timsina, Amy Ballan, Steluta Alexandra Biaudet

Peripheral Cannula Infection

Pages 76 and appendices 3

Published Spring 2024

Diaconia University of Applied Sciences

Bachelor's Degree in Health Care

Nursing/Registered Nurse

When reflecting on the process, it is acknowledged that peripheral intravenous catheter is commonly used in nursing clinical procedures. Additionally, only registered nurses are eligible to perform it.

This study's main objective was to determine how nurses can be encouraged to assess and manage peripheral cannula infection. Based on available evidence, the research revealed the significance of theory and clinical nursing education.

The study was conducted as a literature review. The findings evaluated the nursing concerns about PIVC infection prevention. According to various studies, theoretical knowledge and clinical skills are compulsory in performing the procedure safely and accurately. The material was collected from reliable sources and analyzed carefully.

However, PIVC care and maintenance is obviously demanded. Similarly, accurate documentation of cannula insertion is essential to keep a tracking record of the patient. Aseptic techniques are sustained throughout the PIVC procedure.

The results achieved in this research can be useful in nursing education to teach newly graduated registered nurses about I.V. insertion maintenance. Furthermore, the results can be important in encouraging experienced nurses to pay more attention while settling the catheter.

Everything considered, healthcare professionals contribute successfully to patient safety while conducting PIVC insertion and following aseptic standards.

Keywords: PIVC, education, clinical skills, infection prevention, assessment

List of Abbreviations

I.V./IV = Intravenous

PIVC = Peripheral intravenous cannula

VIP-score =The Visual Infusion Phlebitis score

DVT= Deep vein thrombosis

1 INTRODUCTION

Peripheral intravenous catheters are the most used devices among patients. Catheter-related infections are severe, nevertheless they can be prevented through attentiveness on patient safety. It is preferable that a successful PIVC on the first attempt is obtained. This requires good clinical skills and trustworthiness (Blanco-Mavillard et al., 2019). Nurses are responsible to anticipate possible complications. However, insertion care, and IV therapy administration are considered (Yasuda et al., 2021).

As a result, these may occur due to catheter occlusion, damaged cannula, hematoma, thrombophlebitis, infections, infiltration, or extravasation. Nurses should follow aseptic technique guidelines in a hospital environment. Hand hygiene is the most important method in infection prevention (Sharma et al., 2022a). A healthcare-associated infection should be originated during the investigation or treatment carried out in social welfare or health care services (Communicable Diseases Act, 2016).

Patients might experience local skin irritation, redness, pain, or mild infections. Serious infections might happen sometimes (Sharma et al., 2022a). A European study from 2016 on healthcare infections exposes that 50% percent of patients carried a PIVC in Finnish acute hospitals. Consequently, nurses should maintain high aseptic standards, especially good hand hygiene (THL - Perifeerisen laskimokatetrin asettaminen ja käsittely, 2023).

Registered nurses follow standards in patient care. Competencies obtained from theory and practical knowledge are essential to perform in the healthcare field. Studies confirm that the insertion of cannula in the vein is a task that demands more practice. Self-confidence and following the instructions are high priorities while doing cannulation procedure. In this matter, nurses master peripheral cannula insertion with professionalism (Ravik et al., 2017).

The research issue was initiated after the authors discovered the high annual government payment for treating healthcare-related infections. This prompted them to

explore ways to reduce their infection risk as healthcare workers, specifically focusing on preventing PIVC infections. Improving PIVC management and reducing infection rates can save healthcare institutions a lot of money. With fewer complications, patients don't need to stay in the hospital as long or require extra treatments, cutting down on healthcare costs.

2 PERIPHERAL INTRAVENOUS CANNULA

Evidence studies report that about 80% of patients who require hospitalization receive medication through a vein cannula method (Mewahegn et al., 2022). Anatomical technique is required while conducting a proper cannulation. Additionally, veins can be more observed after the nurse taps her fingers over them. In this manner, veins become more visible and easier to access. Importantly, the patient needs to relax their arms and close their hands (Beecham & Tackling, 2024).

Nurses described that, understanding PIVC insertion and care requires experience and involvement. Similar reasons, patient safety and having a clear picture about infection prevention practices is part of nursing responsibilities. International guidelines are taking into consideration patient care preferences together with IV device. On a final note, improving nurses' participation in care and taking the initiative to diminish patient pain are indispensable (Cooke et al., 2018).

2.1 Reasons for the uses of a peripheral cannula

Peripheral intravenous cannula is the most frequently used medical procedure. It offers direct access into a peripheral vein for administration of medications, IV fluids therapy, transfusions, or blood products (Peripheral Line Placement, 2023, n.d.).

Peripheral intravenous cannula procedure provides patients with immediate access to IV fluids, blood transfusion, water-soluble vitamins, medications, and nutrition. It supplies salts and certain electrolytes to support the electrolyte discrepancy. It provides glucose to the metabolism (Thomas et al., 2020). These fluids are transported directly to the patient’s cardiovascular system (Peripheral Line Placement - StatPearls - NCBI Bookshelf, 2023).

Patient treatment is administered as an infusion or through a syringe. It diminishes body dehydration and helps blood vessels to relax. IV drip therapy relieves pain symptoms. The placement of IV cannula is desired to last for less than 5 days. As a

result, when the treatment is completed, then the cannula is removed (Nancy L. Moureau, 2019).

2.2 Peripheral cannula supplies

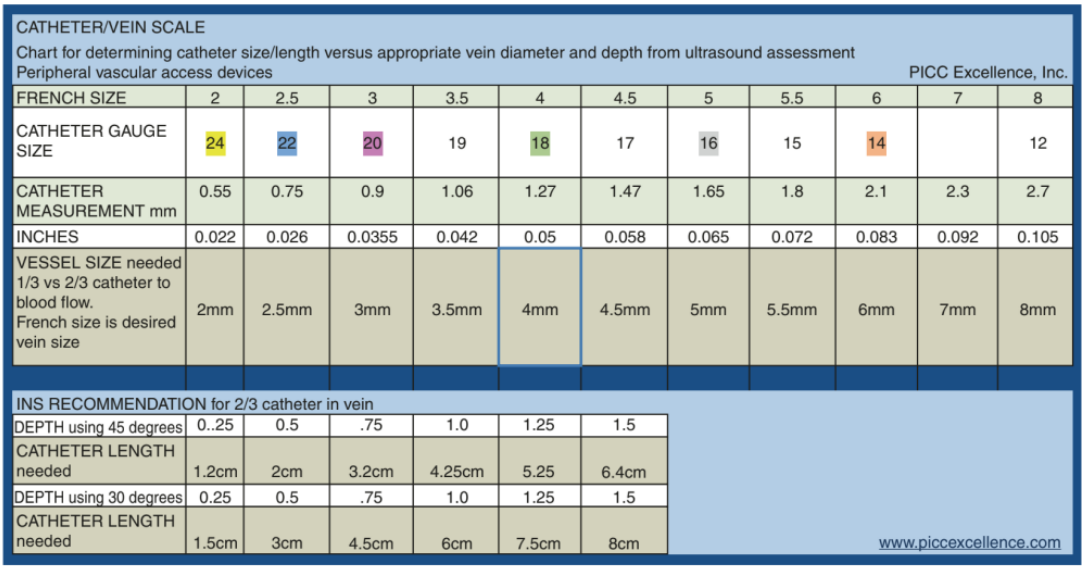
Before starting the procedure, nurses prepare the essential equipment and make sure that the appliances are ready. The tray contains a diversity of cannulas in assorted sizes, needles cap, connector, stabilization device, medical folds, compression bandage, antiseptic, non-sterile gloves, apron, 10ml syringes, a saline solution, and a small sharps bin (see picture 1). The expiration date mentioned on the medical equipment should be checked. All packages are dry, clean, and unopened. Based on patient status, a suitable size of peripheral IV catheter is required (see picture 2 and table 1). Obviously, nurses inform the patient about the reasons for the IV cannula insertion, before the procedure starts (Zingg et al., 2023).

Picture 1: Peripheral IV cannula supplies (Basics of Nursing Practices and Interventions, n.d.)

The Healthcare Equipment and Supplies Act in Finland restrain the reuse of equipment and supplies. It promotes the safety of medical devices (FINLEX ® - Säädökset alkuperäisinä, n.d.). Sharp needlestick injury is still a major risk (Barton, A., Vavrik, B. & Ventura, R., 2017).

Picture 2 contains different PIVC sizes and color codes used in healthcare. Table 1 presents catheter measurements scale.

Picture 2: PIVC sizes (Helsinki, n.d.)



CATHETER/VEIN SCALE

Chart for determining catheter size/length versus appropriate vein diameter and depth from ultrasound assessment
Peripheral vascular access devices — PICC Excellence, Inc.

FRENCH SIZE	2	2.5	3	3.5	4	4.5	5	5.5	6	7	8
CATHETER GAUGE SIZE	24	22	20	19	18	17	16	15	14		12
CATHETER MEASUREMENT mm	0.55	0.75	0.9	1.06	1.27	1.47	1.65	1.8	2.1	2.3	2.7
INCHES	0.022	0.026	0.0355	0.042	0.05	0.058	0.065	0.072	0.083	0.092	0.105
VESSEL SIZE needed 1/3 vs 2/3 catheter to blood flow. French size is desired vein size	2mm	2.5mm	3mm	3.5mm	4mm	4.5mm	5mm	5.5mm	6mm	7mm	8mm

INS RECOMMENDATION for 2/3 catheter in vein

DEPTH using 45 degrees	0..25	0.5	.75	1.0	1.25	1.5
CATHETER LENGTH needed	1.2cm	2cm	3.2cm	4.25cm	5.25	6.4cm
DEPTH using 30 degrees	0.25	0.5	.75	1.0	1.25	1.5
CATHETER LENGTH needed	1.5cm	3cm	4.5cm	6cm	7.5cm	8cm

www.piccexcellence.com

Table 1. Catheter vein measurement scale (Nancy L. Moureau, 2019)

2.3 Anatomy and choosing blood veins.

Before starting the PIVC insertion, the nurse evaluates the veins. She palpates and examines the desired veins of the patient. It is important to recognize anatomical imbalances. In selecting the vein, should be considered risks of nerve injury. Moreover, nurses can also visualize using an ultrasound machine for venous access. This solution is recommended for patients with difficulty in finding the desired vein. The vessels that have bifurcations, are tender or thrombosis should be avoided. The insertion of a short IV canula (less than 7,5cm) is established in the veins of the hand, forearm, or the area of the antecubital fossa (Nancy L. Moureau, 2019). A problem may arise in finding the vein. This situation may occur for the patient that already has numerous cannulation marks. Additionally, if the ventral forearm has flat veins, it makes needle insertion challenging (Baheti & Laheri, 2018).

As expressed, the best veins for PIVC cannulation are superficial and are seen easily. For hands, the most desired veins are digital, metacarpal and basilic veins. On the dorsum of the hand, cephalic veins are seen clearly. For the forearm there is dorsal

metacarpal, median cubital, cephalic and basilic veins. An ideal vein for PIVC cannulation is straight and vertical (Salameh et al., 2019). IV cannulation in the leg area is conducted by a specialist. The Saphenous vein at the knee is good for patients with less intravenous access. Hence, the registered nurse is tapping the veins to accelerate the cannulation. In this way, dilatated veins are accessed faster (Lee et al., 2024).

2.4 Cannula insertion technique

Registered nurses prepare and inform the patient about the PIVC cannula procedure. She washes and disinfects hands properly and uses non-sterile gloves. A tourniquet is placed around the limb. The patient is asked to hold securely the fist. The nurse is checking the desired veins, by palpating the dorsal of hand, forearm, or antecubital fossa. The next step is to clean the skin surface with an antiseptic. Skin is stretched with one hand and with the other hand cannula insertion is proceed. Open the cannula wings. The cannula is inserted until blood is seen, which means it is in the right place (Baheti & Laheri, 2018). The tourniquet is removed.

The nurse should press over the vein to anticipate losing blood. The needle is removed and thrown away into the sharp small box. In case the vein is not seen easily, a warm compress can be added on the desired area. It is important to remember to work ergonomically. Therefore, the patient should be advised to stay calm (Peripheral Line Placement - StatPearls - NCBI Bookshelf, 2023).

This clinical technique requires a needle to enter a desired vein. Hence, the cannula is settled. When the cannula is secure, the needle is withdrawn. An insecure cannula has a major infection threat (Baheti & Laheri, 2018). Occasionally, it is not easy to find the desired vein. Another issue is that once found, the vein may vanish fast. A nurse tries two times the IV cannulation. In case the action is not working, then another nurse starts the procedure. However, in case of non-success, then an anesthetist is taking charge of the process (Laskimokanyylit. Sh Oskar Nyholm - PDF Ilmainen Lataus, n.d.).

3 NURSING ASSESSMENT AND CARE

The first step in nursing is to gather and organize information about a patient. This inclu des looking at their cultural, spiritual, and physical needs. Nurses use critical thinking to make decisions and create a care plan tailored to the individual, rather than using a one-size-fits-all approach. This careful and personalized approach leads to better results for the patient (Toney-Butler & Unison-Pace, 2024).

Nursing assessment of peripheral intravenous catheter includes assessment of PIVC insertion site, PIVC dressing and IV lines, valves, port. Based on research about infection risks and prevention processes, several strategies have been recommended to prevent PIVC infections (see table 2).

3.1 Assessment of insertion site

To ensure the safety and effectiveness of PIVC, a thorough and systematic assessment is crucial. PIVC insertion site assessment is examined by visualising, palpating and regular assessment in every shift for early diagnosis and intervention (O'Grady et al., 2011). The examination can be started visually by evaluating the site. Confirm the correct PIVC position, check for any sign of migration or dislodgment. Check the skin around the insertion site for redness, swelling or soreness. To confirm abnormalities, compare the site with another site or similar limb (Nursing Guidelines: Peripheral Intravenous (IV) Device Management, n.d.).

Palpating is a technique that supports visual assessment by gently touching the area around the insertion site. Check the cannula is well- secured and does not cause any pain or discomfort. Functional assessment can be done by flushing the cannula and checking if it migrates. This ensures the drugs and fluids flow smoothly, reducing the chance of migrating leading to complications. In case of any types of infection or migration into surrounding tissues, it is critical to stop infusion and chose different vein for PIVC insertion (O'Grady et al., 2011).

3.2 Care of PIVC

Changing cannula: PIVC should be changed every 72-96 hours or encase of any signs of infection. Noticeably, if the cannula was inserted in an environment which was not aseptic or in an ambulance, it should be changed as soon as possible. Therefore, if the cannula is no longer required, it must be removed as soon as possible (Department of Health & Communicable Diseases Branch, 2018).
The transparent protective adhesive film should be changed in every 5-7 days, when it becomes loose or if any moisture/ blood accumulates under the protective film. The date when, the film has been changed should me marked on the film. The change is done by disinfecting hands and using factory-clean gloves. The area of insertion site is disinfected with ≥70% alcohol or 2% chlorhexidine-alcohol. Sterile gauze is damped with NaCl (0.9%) to wipe any dry blood or dirt. The insertion area should dry thoroughly before applying new films (Perifeerisen laskimokatetrin asettaminen ja käsittely - THL, 2023). Sterile gauze is used under the film, if the insertion site discharges or if patient sweats a lot. In this case the sterile gauze is changed every other day (HUS, n.d.).

IV-lines, valves, port: Before processing any part of PIVC disinfect hands is critical. A PIVC is ready to use when needleless (Q-syte) and disinfected cap is used, if placed for at least 1 minute (Pohjois-Pohjanmaan Sairaanhoitopiiri, n.d.). In case needleless or any other ports does not have disinfected cap, it must be disinfected with single use with ≥70% alcohol swab or 2% chlorhexidine-alcohol for 15s. The system is ready to use once completely dry, prior and after using the port/ valve it should be flushed with 5-10ml NaCl 0,9% (Department of Health & Communicable Diseases Branch, 2018). The frequency of changing I.V. lines depends upon their specific usage, categorized as ongoing, periodic, or as needed infusions. In case of one-time or as-needed orders, I.V. lines are replaced immediately after use. Additionally, IV lines are mandated when guided by medication labelling instructions (Pohjois-Pohjanmaan Sairaanhoitopiiri, n.d.).

Ongoing IV infusion lines are changed according to fluid instructions which can vary from between 4- 24 hours. According to some fluid infusion instructions, the administration set should be changed between every use to 96 hours or during the time of cannula replacement. The administration set consists of the IV lines, valves and the

fluid bag (Department of Health & Communicable Diseases Branch, 2018). The Q-syte should be changed if there is backflow of blood which can't be flushed, immediate after blood infusion, after taking blood sample. It can also be replaced as needed according to the administration of IV infusion or every 3-4 days as scheduled (Pohjois-Pohjanmaan Sairaanhoitopiiri, n.d.).

Table 2: Strategies to prevent PIVC infection and hypothesis behind the strategies. (O'Grady et al., 2002) (Pohjois-Pohjanmaan Sairaanhoitopiiri, n.d.)

Strategies to prevent	Hypothesis
Choosing correct insertion site. Hand veins are ideal site	Poor anatomical site influences infection risk. Wrist or upper arm have higher density of skin flora, higher infection risk.
Aseptic technique and hand hygiene	Disinfecting the insertion site and not touching it before insertion.
Insertion site dressing Applying sterile transparent polyurethane adhesive	Protects insertion site from bacteria and viruses. Keeps it dry and is breathable. Transparency helps assessing the site.
Dry and clean insertion site	Bacterial colonisation prevention.
Disinfecting port and capping when not in use	Wiping 70% alcohol wipe for 5s-10s, before using the port. Port gets easily bacterially colonised. Straight connection to bloodstream.
Following PVC replacement guidelines	Decreases and prevents infection risk.
Documentation in patients' medical record	Keeps care up to date, helps elective replacement.

3.3 Purpose of Documentation

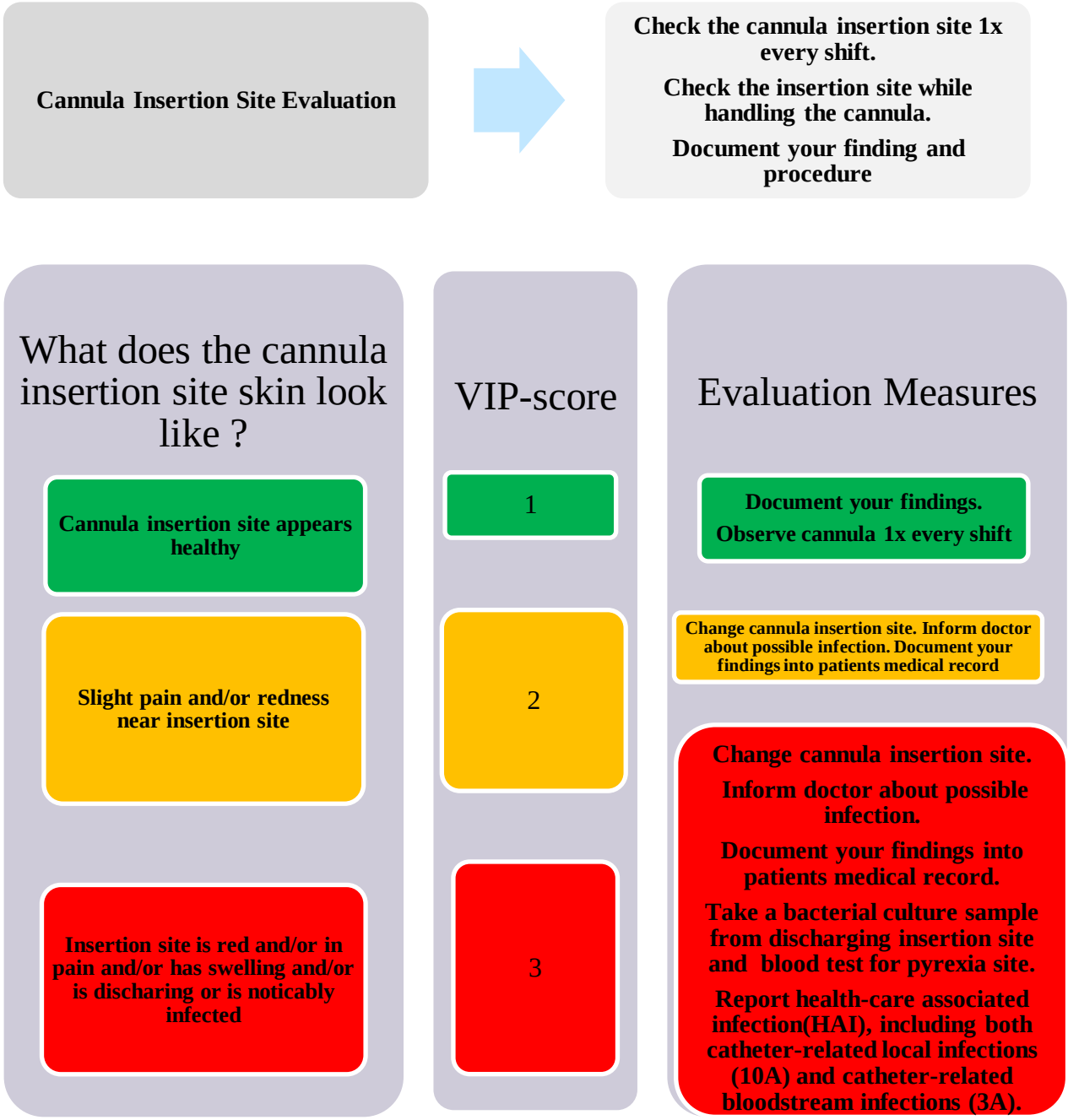
Documentation is used to help in patient care planning, implementation, monitoring, and evaluation, as well as to ensure continuity of treatment and protect the patient's right to information. Documentation is used to measure efficacy and quality management while also offering legal protection for patients and healthcare workers. Recorded patient information must be recent, accurate, error-free, understandable, and detailed (Potilashoidon Kirjaamisen Tarkoitus Ja Sisältö - Duodecim Oppiportti, n.d.).

Cannula documentation is written in the patients' health record. In the health record, the insertion site, maintenance, and removal date of cannula is mentioned. To be added if the cannula was already placed upon admission.

The assessment of cannula is concluded and documented using VIP-score in monitoring form. VIP- score stands for The Visual Infusion Phlebitis Score (see table 3).

Table 3: Guide for nurses to use VIP- score to assess PIVC infection

(Kanyylin Juuren Ihon Arviointi Aikuisilla (VIP-Score). Pdf, n.d.) & (HUS, n.d.)



3.4 Infection and complications

In Finland, the Communicable Diseases Act §3 states that “a communicable disease refers to any disease or infection caused by microbes, their components, or parasites which multiply in the human body”. To state the infection to be a healthcare-associated infection the infection must be originated during the investigation or treatment carried out in social welfare or health care services (Communicable Diseases Act, 12272016).

Complications from PIVC can put patient safety in grave danger, lengthen hospital stays, and raise medical expenses. Intravenous cannulation has its risks associated with it, such as occlusion, leakage, extravasation, phlebitis, clotting, and infection despite its advantages and widespread use (Baye et al., 2023).

Studies discussed peripheral intravenous catheter failure, including catheter gauge, catheter care and patient age. Emphasizing that conducting an unsuccessful PIVC insertion many times by a nurse is not appropriate. This can be uncomfortable for the patient, for example needle phobia or the desire to avoid hospitals. Obviously, it is significant that insertion techniques should be improved among nurses (Marsh et al., 2021).

Infection

Cannula infections are defined as local infections, including injection site, subcutaneous tissue, and cannula infection, or general infections which are bacteremia and sepsis derived by cannula (Ala-Kokko et al., 2000). Bacteremia is a condition where there are bacteria in the circulatory system. Bacteremia implies both circumstances including harm to at least one organ and circumstances where no organ harm has happened. Sepsis is defined as an inflammatory reaction caused usually by bacteria that cause harm to at least one organ (Anttila, 2024).

It is known that injection port contaminations are often due to sensitive areas where microbial growth is easy to occur. Hence, this may develop into blood stream infections. IV cannula infections may occur on the skin, by microorganisms such as Staphylococci or related to bowel flora, for example Pseudomonas, Enterococcus,

Serratia, Enterobacter or Klebsiella. This can be transmitted when assessing the cannula by touching hands between patient and registered nurse when aseptics are not effectively accomplished (Rai et al., 2019).

Phlebitis

An inflammation known as thrombophlebitis, or phlebitis, results in the formation of a blood clot in a vein, commonly in the leg. When it affects a vein near the skin's surface, it is called superficial phlebitis. Deep vein thrombosis is the term for it when it affects a deeper vein (DVT) (Kettunen, 2020). It is evident that nursing intervention is very important, because phlebitis incidence provoque unwanted symptoms: tumefaction in the vein, fever, heat, pain or irritations. Nurses should conduct routinely PIVC evaluation and follow the protocols and guidelines from their department (Guanche-Sicilia et al., 2021).

Phlebitis generates unpleasantness to the patient. Likewise, it leads to aggravation such as septicemia or cellulitis, therefore the patient must spend more time in the hospital. This situation will raise the healthcare costs. It is observed that phlebitis appears in emergency circumstances when catheter is inserted faster (Mandal & Raghu, 2019). It is essential that nurses are aware of possible risks such as phlebitis and take responsibility for good patient care. Minimizing the appearance of phlebitis includes choosing the proper catheter for the specific patient. Studies discuss that many nurses do not perceive the significance of such complications due to not having enough clinical knowledge. To be concluded, training and work experience contributes to the quality of care offered to the patients (Milutinović et al., 2015).

Other complications

Other complications include infiltration, extravasation, clotting, occlusion, and leakage. Intravenous infiltration is the outflow of fluids from an incision into surrounding tissue during an infusion. Extravasation of a vesicant can result in blisters, serious tissue damage, or necrosis (Gibian et al., 2022). Occlusion is a barrier to the

flow of intravenous medication or fluids, and it is one of the most common causes of catheter function loss (Baye et al., 2023).

PIVC dislodgements may occur if the catheter is not secure in the desired place. It is essential that the catheter is visible and fixed. Otherwise, external contamination risks may happen when patient moves or is transported. Dislodgement has a serious effect on the delay of treatment, patient anxiety and costs of hospitalization (Schmutz et al., 2020).

4 NURSING EDUCATION

Peripheral intravenous cannula education is based on nursing knowledge and practical skills. The goal of advanced education of PIVC is to identify and prevent major risks and improve patient care experience. In hospitals, confidence is obtained while often practicing the insertion of cannula. E-learning trainings are organized for nurses and students to understand concerns about PIVC. In addition, to learn IV cannulation techniques and to boost patient safety. Interactive online materials are accessible for further development (K. R. Glover et al., 2017).

Nursing students gain educational theory and practical experience about PIVC in university of applied science and in the hospitals. They get prepared to be ready and confident for working life. Clinical skills are improved, and students are aware of possible complications while inserting the IV cannula. Aseptic guidelines, patient safety and problem-solving are essentials for a successful IV insertion. Therefore, innovative methods to improve nursing knowledge and preparation before the procedure are considered (Osti et al., 2019).

4.1 Learning process through video material

In modern times, learning and teaching is more digital, with the use of instruction videos. Learning experience through videos has many advantages in comparation with classic literature. Internet access gives valuable opportunities to self-education and self-development. To be mentioned that, learning manners is individual. It includes observational, learning through discovery, problem solving and information gathering skills. E-learning provides access to free online education. Demonstrative videos involving interactive workshops where students participate add value to e-learning strategies (Carter et al., 2020).

E-learning offers access to creativity, innovation and can be used positively at any time. It is a fast way of studying and a good communication type between nursing students and teachers. Students can follow their study path and can utilize different digital methods of testing their own knowledge. Hence, online training can be updated

for the requirements of the students. New learning portals are planned continuously (Sharma et al., 2022b)

4.2 Simulation workshops

A variety of simulations helps nurses to improve their practical skills. Interactive learning PIVC workshops are organized for students. These are self-study methods conducted in small groups. Instructions are offered from the beginning. Students may evaluate their performance by monitoring each other's work and offering feedback. Working in pairs gives the chance to practice PIVC skill step by step.
The learning procedures focus on getting familiar with the PIVC supplies, aseptic methods, nurse patient roleplay interview simulation and carry the PIVC insertion safely (K. R. Glover et al., 2017).

Based on available evidence, PIVC education helps nursing students to gain nursing knowledge, confidence, and aseptic techniques. Participating in university workshops, students have the chance to get the necessary resources to perform a PIVC insertion without possible complications. Practice-based education is successful and innovative, improving live clinical procedures in hospitals (K. Glover et al., 2017). It is relevant to mention that not all the universities provide PIVC training. Therefore, students PIVC knowledge and skills are often improved once they start working (García-Expósito et al., 2021).

4.3 Importance of educating nurses and student nurses

In healthcare, educational meetings are organized frequently. Nurses and students should have knowledge about symptoms and side effects. Prevention of complications such as infections or catheter damage. PIVC theory and evidence based simulated procedures are included in the hospital learning training. Healthcare professionals are updated constantly about guidelines during insertion and after catheter removal (Gil, 2015).

Knowledge and skills are required by participating in training. Nurses should master how to manage a cannula without creating complications. Upon reflection, if the nurses aren't well prepared for PIVC insertion, they can put the patient in danger. Continuous learning, patient oriented-practices and interpersonal skills are tasks that require attention and awareness (Sr. Litty Sh & Rani, 2021).

Educating nursing students about PIVC management happens through theory and practical procedure in university of applied science. An important aspect influences the patient's safety. Clinical training is evolving continuously because students learn and understand differently. In the insertion of PIVC they should master anatomy and physiology, to avoid complications. Considering all these points, respecting PIVC guidelines supports the best clinical practice procedure (Catarino et al., 2022).

4.4 Aseptic Guidelines

Nurses should follow aseptic guidelines to prevent possible PIVC infections. Finnish healthcare system considers that the one-way alcoholic wipe is the best method to avoid infection risks (Perifeerisen laskimokatetrin asettaminen ja käsittely - THL, 2023).

Sterility is substantial when inserting cannula. Hands are always disinfected before setting PIVC cannula. Hands are disinfected before and after touching, such as the patient or infusion bags. When administering medication or connecting the infusion lines it is not mandatory to wear protective gloves. To be mentioned, hands are disinfected every time prior and after wearing gloves. The puncture point of cannula and the bandage should be checked regularly. Touching the area should be avoided. The PIVC is assessed every shift conforming with the VIP score. Once the cannula is not needed, it should be gently removed (Hoitoon Liittyvien Infektioiden Torjunta 2024, n.d.).

Hospital environment requires to follow up aseptic standards. Clinical practices for such as PIVC insertion are a sensitive procedure and take full responsibility and careful assessment. The condition of IV cannulation should be optimal and safe for the patient.

Quality of care and minimizing infection risks are important factors in health centers. Managing IV insertion unstained and with attentiveness is part of the clinical procedures for nurses in their daily working task (Catarino et al., 2022).

5 AIM AND PURPOSE

This thesis seeks to evaluate how different assessment techniques contribute to preventing infections associated with PIVC. Through investigation, this aims to gain insights into the effectiveness of these methods in infection prevention. By optimizing PIVC management practices, nurses can enhance patient safety, reduce infection rates, improve clinical skills. The main aim is to recontribute to cost savings within healthcare systems, allowing resources to be redirected to areas of greater need.

Research question: What are the most advantageous methods in helping nurses with assessment and managing peripheral cannula infection?

6 LITERATURE REVIEW

Literature review is a method to search and collect research data. Therefore, it gives an alternative perspective over the context of the subject. It makes a strong connection between theoretical and practical experience. It is essential to consider planning, structuring and critically evaluating a literature review. This method is a performant tool for academic writing (Leite et al., 2019, p. approach).

The development process contains the following steps: defining search scope including the research question; identify the literature acquired through journal articles, books, dissertations; analyzing the literature in a critical manner; categorizing the resources and reflecting on the writing, such as checking if the text is coherent (Conduct a Literature Review, 2024, n.d.).

It is commonly referred to in the scientific domain, due to its contribution that brings to an academic paper. Searching for quality literature reviews involves scanning and exclusions of certain articles, due to their insignificance. A high-class subject means it is interesting to the researcher, covers the importance of the thesis aim and is no older than ten years. It is essential to minimize bias by being careful while selecting literature sources (Winchester & Salji, 2016).

Peripheral cannula infection prevention topic integrates theoretical and practical aspects included in a nursing environment. To be mentioned, hypotheses, critical analytical skills and clear information are presented with the help of literature review. How can nurses prevent peripheral cannula infection? Finding proper sources, and considering literature review, contributes to the development of the research (Paré & Kitsiou, 2017).

The research is well organized and presents a variety of knowledge from different sources about peripheral cannula infection. Performing a systematic review contributes to the knowledge that one already has about infection prevention. In this thesis, literature review demonstrates evidence-based care interpretation. It evaluates the articles and shows the reader the progression of the topic involved. Focusing deeply

on the research question suggests arguments and ideas to be clarified. These are organized in the paper with the literature review contribution (Paré & Kitsiou, 2017).

Considering all these points, the research establishes a various and carefully evaluated literature review checklist. As expressed, the systematic literature review method adheres to the analytical interpretation of the data. Noticeably, a lot of quality work is done by critically collecting, evaluating and displaying findings from various research studies. Extracting and analyzing data consciously played a vital role in this research. Interpreting, understanding, reading, synthesizing and discussing of findings from different publications focusing on PIVC research aim is concluded.

6.1 Inclusion and exclusion criteria

Inclusion criteria are defined as the key characteristics of the target population that researchers use to answer the research question. In contrast, exclusion criteria are characteristics of potential research participants who meet the inclusion criteria but have additional characteristics that may compromise the success of the study or increase the risk of adverse outcomes (Patino & Ferreira, 2018).
This literature research followed specific criteria. Articles had to meet the following conditions: they must be written in English and published within the last decade, be relevent to the research question, be peer reviewed, and be freely accessible.

Table 4: Inclusion and exclusion criteria in the process of literature search

Inclusion	Exclusion
Published between 2014 to 2024	Published before 2014
Articles in English	Articles in any other language, which researchers cannot understand
Relevant articles according to the research question	Irrelevant articles which don’t answer the research question
Articles which are peer-reviewed	Articles which are not peer-reviewed
Articles that are full text, accessible for free	Articles which are not free, has only limited access

6.2 Data collection

Data collection is the process of acquiring and assessing data on relevant variables in a predetermined, methodical manner to address research questions, test hypotheses, and assess results (The Office of Reasearch Integrity, n.d.).
The databases used are reliable such as Academic Search Premier, which is multidisciplinary database contains active full text for over 3,100 journals, including almost 2,750 peer-reviewed journals. CINAHL, which is the world's most comprehensive full-text source for nursing and allied health articles, with over 1,300 titles. ProQuest Health Research Premium Collection, which is part of Clarivate, provides outstanding research, education, and library solutions. Sage Journals, which is an independent organization with a portfolio of more than 1,100 journals including over 200 golden open-access journals. Taylor & Francis Social Science and Humanities Library (SSH) is one of the world's leading publishers of open-access research. National Library of Medicine (PubMed), which contains 36 million citations of biomedical literature from MEDLINE, life science journals, and online books. Springer Link part of Springer Nature enables easy access to an extensive online collection of journals, e-books, and protocols in a wide range of fields. DOAJ: Directory of Open Access Journals is a unique and comprehensive index of a diverse range of open access journals from around the world. These databases were utilized because they include peer-reviewed, scientific papers authored by scientists and experts in their field. These databases also offer strong search options for refining results and a critical overview of systemic reviews.

Beginning the search in Academic search premier the search words were PIVC or peripheral intravenous cannula or peripheral intravenous catheter AND infection prevention, which resulted in 54 hits. With the inclusion of full text, and publication Date: 2014-2024 resulting in 22 hits. From 22 hits 6 articles were chosen for this study.

CINAHL the search words to peripheral cannula or peripheral intravenous catheter AND nursing AND infection control OR Education resulted in 56 hits. With the inclusion of free full text, academic journal, in English, and publication date of 2014-2024, 22 hits remained. From 22 articles 2 were chosen. The search words peripheral cannula or peripheral intravenous catheter AND infection AND prevention yielded in 19 hits. From 19 articles, 5 were selected for this study.

ProQuest was the second database that was used. The search words PIVC AND infection AND prevention resulted in 55 hits. With the inclusion of peer-reviewed and publication date last 10 years, resulting in 16 hits, 1 was selected for this study. Changing the search words to PIVC AND nursing education yielded 50 hits. With the inclusion of 2015-2024 and Full text, 14 hits were found from which 2 were selected for this research study. With the search words Student education AND PIVC 14 hits were yielded. With the inclusion of 2015-2024 still, 14 remained and 2 were selected for this study. The next search words that were used were PIVC in hospitals AND education AND nurses yielding 42 hits. With the inclusion of 2017-2023 and Full text, 13 hits remained, and one was selected for this study.

Using the Taylor & Francis Social Science and Humanities Library (SSH) database, the words PIVC AND infection AND prevention were applied resulting in 16 hits with the inclusion of 2014-2024, 7 hits were found, and one was selected for the study.

Using Sage journals database with the search words PIVC nursing education resulted in 66 hits. With the inclusion of 2020-2024, 42 hits yielded. From those 42 hits only one was selected for this study.

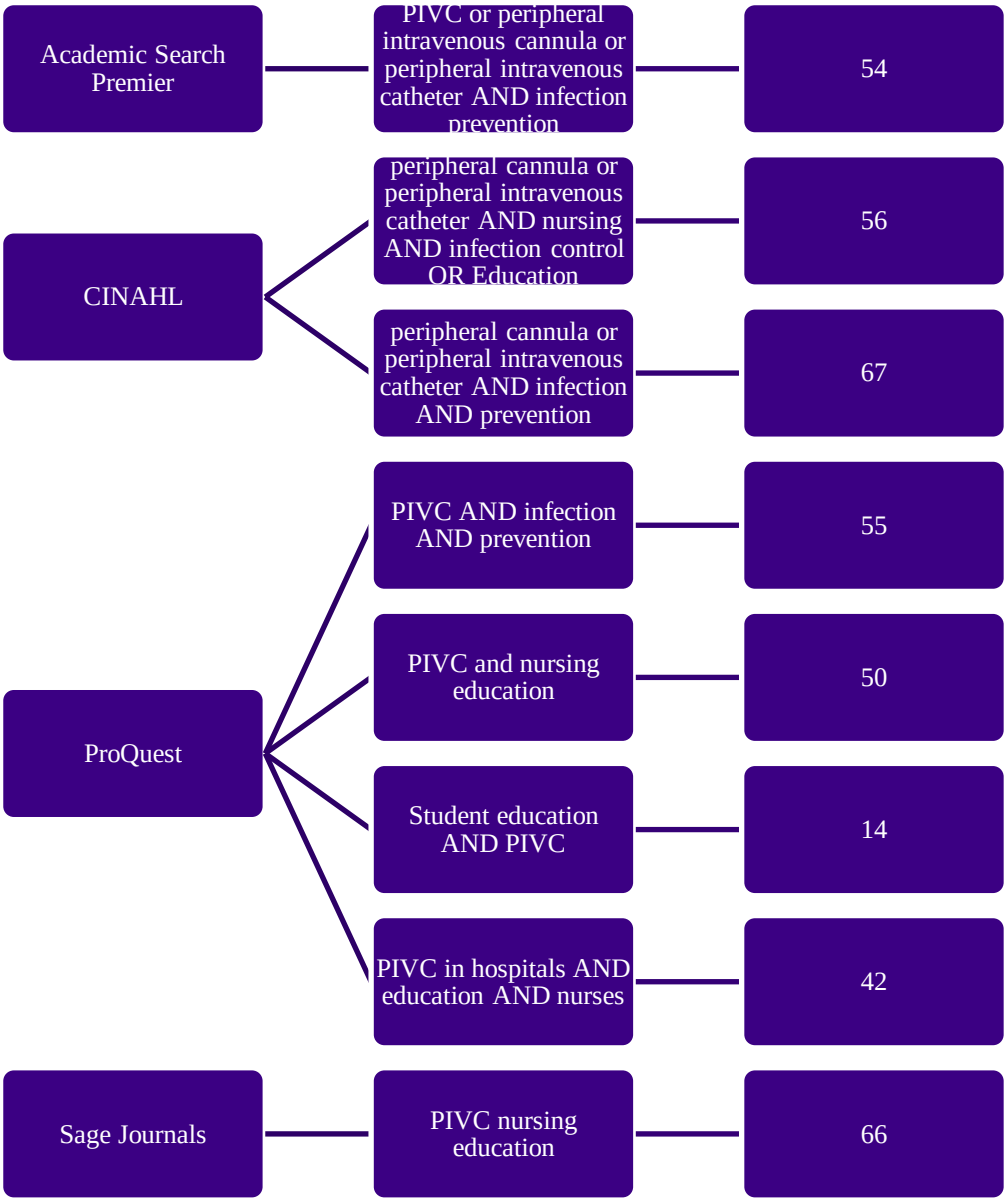
PubMed resulted in 398 hits with the search words PIVC or peripheral intravenous cannula or peripheral intravenous catheter AND infection prevention. With the inclusion of publication date in 10 years and full text, 182 hits remain. From those 182 articles, only 2 articles were selected for this study. The search words Nursing education AND PIVC OR peripheral catheter resulted in 382 hits. With the inclusion of full text, 176 hits remained. From those 176 articles, one was selected for this study. The search words peripheral cannula or peripheral intravenous catheter AND nursing AND infection control OR education resulted in 496 hits. With the inclusion of free full text, academic journal, in English, and publication date of 2014-2024, yielded 108 articles, 3 articles were chosen for this study.

In the database, Springer Link, the search words Nursing education in PIVC resulted in 39 hints. With the inclusion of 2020-2024 and category: Nursing and Nursing Research, 6 articles remained. From 6 articles one article was selected for this study. The search words PIVC students practice resulted in 71 hits. With the inclusion of

2015-2024, 53 articles remained, and one article was selected for the study (see table 5).

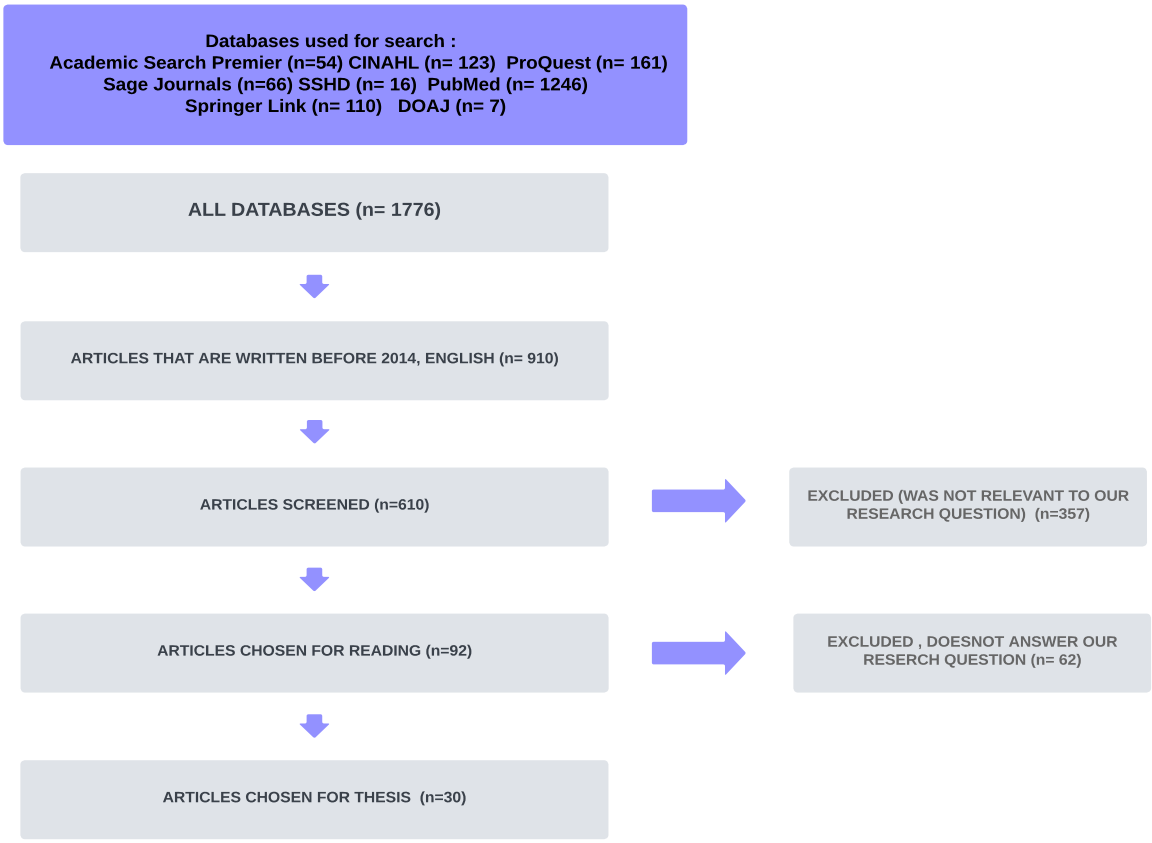
DOAJ: Directory of Open Access Journals yielded 7 hits with the search words PIVC nursing. From those 7 articles, one was selected. A total of 30 articles were chosen from various databases for this literature review. Each article was assessed for credibility and relevance (see flowchart 1) .

Table 5: Keywords. The table below shows the keywords used and the hits that yielded from those keywords.




Taylor & Francis Social Science and Humanities Library (SSH)
PIVC AND infection AND prevention
16
PUBMed
PIVC or peripheral intravenous cannula or peripheral intravenous catheter AND infection prevention
368
Nursing education AND PIVC OR peripheral catheter
382
peripheral cannula or peripheral intravenous catheter AND nursing AND infection control OR Education
496
Springer Link
Nursing education in PIVC
39
PIVC students practice
71
DOAJ: Directory of Open Accsess Journals
PIVC nursing
7

Flowchart 1 : Shows the process by which the thesis articles were chosen.



Summary table of article selected

In the final phase of the data retrieval process, 30 articles were selected. A summary table of these articles was created, detailing the title, authors (in alphabetical order), year of publication, research country, methodology, and results. The summary table of the chosen 30 articles can be found in appendix 1. Appendix 2 shows the list of the selected articles.

6.3 Critical appraisal

The literature was critically evaluated using the 'JBI Critical Appraisal Checklist for Qualitative Research'. Systematic review is a methodological process that evaluates research evidence to determine the methodological quality of a study and potential bias. All papers selected for inclusion undergo rigorous evaluation by two critical appraisers. JBI Critical appraisal tools, approved by the JBI Scientific Committee, are used to develop Critically Appraised Topics (CAT), journal clubs, and educational materials (Lockwood et al., 2015). The authors individually reviewed search articles from data collection to assess the quality of the literature, and then the articles were critically appraised by two appraisers. This was completed to determine the study's quality.

Appendix 3 includes the 'JBI Critical Appraisal Checklist for Qualitative Research'.

6.4 Content Analysis

Content analysis is a technique used to methodically examine different kinds of textual or visual material, such as written documents, speeches, photos, and interviews, to get insightful knowledge about a given topic. To find patterns, themes, and concepts that are present in these sources, it involves systematically going over their content (Kyngäs et al., 2019).

Content analysis can be either inductive or deductive. Inductive content analysis involves allowing concepts, categories, and themes to emerge from the data itself, while deductive content analysis applies pre-existing theories or frameworks to the data. This literature review is done using inductive content analysis (Kyngäs et al., 2019).

Handling content analysis required reflecting and embracing intuition. The path was to read and re-read various data by concentrating on the aim of the thesis. In other words, the process was understanding the context and accepting multiple perspectives. Collaborating between the group members provided the abundance of collected data. Content analysis interprets deeply the text, in a complex and fascinating manner. This is a process of analyzing and comparing data consecutively. Likewise, avoiding bias is fundamental (Erlingsson & Brysiewicz, 2017).

The first step included determining the unit of analysis, and 30 publications were carefully studied. Gathering all the relevant documents or sources that contain the information regarding the research question. Then the next step started by systematically going over each piece of literature. This process involves summarizing key findings, themes, concepts, and methodologies used in each study. Lastly, following the inductive procedure, which involves reading articles, taking notes, and organizing data into minor categories and major categories (themes).

The minor categories are formed from the research articles, which are: Essential skill development, cannulation techniques and placement, Documentation Procedures, Risk Assessment and Management, Complication prevention and management, Risk assessment indicator, Patient-centered care, Quality of care, Nurses awareness, Education on asepsis technique, Assessment and Monitoring Tools, Nurses' Experiences and Observations, Learning Impact for Nurses and Nursing Students, Clinical Practice Guidelines for PIVC, Innovations in Catheter Securement and Dressings, E-learning, Self-evaluation and teacher/work instructor constructive feedback.

Each is divided into suitable major categories: Infection Prevention Strategies, Assessment of PIVC infection, Risk factors and management, Theory training, Clinical Practice. Two themes have been compiled from the categories: Improving PIVC management to prevent infection and Enhancing Nursing Knowledge (see table 6).

Table 6: Preventing PIVC infection through education and clinical training development.

THEMES	Improving PIVC management to prevent infection.			Enhancing Nursing Knowledge	
Major categories	Infection Prevention Strategies	Risk factors and management.	Assessment of PIVC infection	Theory training	Clinical Practice
Minor categories	Essential skill development, cannulation techniques and placement, Documentation Procedures, Risk Assessment and Management, Complication prevention and management, Risk assessment indicator, Patient-centered care, Quality of care, Nurses awareness.			Education on asepsis technique, Assessment and Monitoring Tools, Nurses' Experiences and Observations, Learning Impact for Nurses and Nursing Students, Clinical Practice Guidelines for PIVC, Innovations in Catheter Securement and Dressings, E-learning, Self-evaluation and teacher/work instructor constructive feedback.	
Unit analysis	1, 2, 5, 6, 8, 9, 10, 13, 14, 17, 18, 19, 22, 23, 24, 25, 28, 29, 30			2, 3, 4, 6, 7, 8, 9, 11, 12, 15, 16, 20, 21, 24, 26, 27	

7 RESULTS

The chosen themes are connected when reflecting them in the thesis. Conducting secure PIVC procedures are indicated for the safety of the patient. Therefore, advanced theory and practical PIVC education are required. The themes are relating to teaching healthcare professionals, infection prevention, possible risks, documentation, patient safety and PIVC insertion improvement.

Preventing PIVC infection through education and clinical care development demands awareness and confidence attitude from nurses and students. Scientific studies confirm the significance of infection prevention and patient safety. Additionally, effective training improves clinical nursing skills.

7.1 Improving peripheral intravenous cannula (PIVC) management to prevent infection.

Nurses play a crucial role in preventing infections associated with PIVC access, they must adhere to infusion therapy standards of practice. There are multiple ways nurses can assess or manage PIVC early on, hand hygiene, decontamination, selection of PIVC/ insertion site, disinfection have an impact on PIVC infection. By consistently implementing aseptic technique during IV insertions, conducting regular site assessments, managing IV equipment properly, and using transparent dressings, healthcare providers can significantly reduce the risk of infections and improve patient safety. Variations from evidence-based methods PIVC care must be addressed. It is crucial for healthcare professionals to have a deep understanding of and consistently apply these infection prevention strategies to ensure the delivery of high-quality and safe patient care (de Sousa Salgueiro-Oliveira et al., 2019; Nickel, 2019; Zhang et al., 2016).

Evidence-based insertion principles are not fully respected in all hospitals, due to lack of time and awareness. Coordination, resources, and commitment from hospital sections is mandatory. However, in the emergency section, approaching difficult intravenous access patients became successful. Effective training contributes to

positive changes. It is obvious that lack of education offers a low comprehension of the insertion sites (Bahl et al., 2024). Students can review, add value, and be active in their learning. For example, how to optimize the care of IV cannulation? Study findings identify the students' confidence while performing IV cannulation. To be mentioned, the unsuccessful attempts and feedback from the supervisor influence their PIVC performance skill (Hernon et al., 2023).

Assessment of PIVC infection

Proper assessment is paramount in the management of PIVCs to avoid complications and bloodstream infections. When assessing a PIVC infection it's necessary to identify infection indicators and symptoms, evaluate the state of the PIVC dressing and IV connections, and guarantee the proper treatment. By utilizing insertion and maintenance bundles, healthcare professionals can increase the overall success rate of PIVC insertions while decreasing the occurrence of complications, resulting in better patient outcomes. Regular evaluation is key to the prevention and early detection of IV complications (Høvik et al., 2019; Ray-Barruel, 2017; Ray-Barruel et al., 2019).

Unfortunately, it is a very common issue found in hospitals that nurses lack education and practices regarding assessment, which leads to common issues found including unwanted insertion sites, larger-than-recommended sizes, and a lack of documentation (Høvik et al., 2019). Continuous monitoring processes should be developed to constantly observe the results of PIVC. These processes include identifying and using consistent criteria, training staff to assess and document PIVC access. It is essential to share results with staff to assess and plan follow-up (Nickel, 2020).

Infection Prevention Strategies

Prevention and management strategies have a huge impact on lower infection rates. Strategies such as patient education, strict infection control measures, minimal insertion attempts, appropriate cannula material selection, frequent monitoring for complications, and collaboration among healthcare providers. These tactics seek to

improve patient outcomes, lower complications, and increase PIVC safety (Korkut et al., 2022).

Aseptic and hand hygiene techniques should be always used. Thorough skin disinfection prior to insertion, coupled with appropriate cannula protection, monitoring, and care should be performed in accordance with evidence-based practice guidelines (Munoz-Mozas, 2023). Therefore, better insertion techniques may be developed to reduce the occurrence of PIVC problems (Abolfotouh et al., 2014). The selection of a securement device and wound dressing has a major effect on the rates of complications and infection prevention. To maintain an infection barrier and guarantee PIVC stability, a variety of dressing and securement methods are used. To be mentioned, sutureless securement devices and dressings treated with antimicrobials. Appropriate securement techniques lower the chance of problems including infection, phlebitis, occlusion/infiltration, and leakage. Preventing PIVC failure and unexpected restarts and minimizes patient discomfort. Additionally, ameliorate patient suffering related to reinsertion while guaranteeing continuous treatment (Marsh et al., 2015). Changing catheters is recommended as clinically required rather than routinely after 72 hours after insertion, which reduces the number of insertions per patient and consequent difficulties (Abolfotouh et al., 2014).

Patients can play an important role in infection prevention, this highlights the importance of patient education. The study conducted by Blanco-Mavillard et al. in 2022 found that the participants in the study did not engage in patient education. These findings are alarming, but they emphasize the missing possibilities to patient education. In addition, educating the patient about PIVC is essential to comprehend the importance of hand hygiene and asepsis (Purssell, 2017).

Risk factors and complication management

Study focused on the multiple trials of IV insertion using peripheral intravenous catheters or midline catheters. Even though the PIVC need is far up, one in three crashes for involuntary issues. Based on available evidence, such example is infectious complications (Marsh et al., 2024). Patients with difficult intravenous access are eligible for ultrasound guided peripheral cannulation. This procedure minimizes the

unwanted dilemmas. It is recommended for nurses to identify instantly the patients with difficult intravenous access. In this way, the proper supplies could be organized prior to the insertion. However, using the ultrasound device in performing IV cannulation doesn't require many years of experience (Hoskins et al., 2023).

7.2 Enhancing Nursing knowledge

Educating nurses and students for being able to perform PIVC insertion is foremost. Consciousness provides a good understanding to anticipate possible problems. Most articles aim is based on updating learning methods for healthcare professionals continuously. Additionally, the variety of learning methods available such as online learning facilitates the study motivation for nursing students (Hernon et al., 2023).
As expressed, ongoing education and training are crucial for maintaining a high standard of care in patients. To improve nurses´ performance, they must be provided with structured teaching programs and simulation- blended practices (Bayoumi et al., 2022).

In general, there are multiple techniques developed to evaluate nurses´ knowledge about bloodstream infection prevention measures connected to cannula use. One such technique involves the creation of a scale developed to assess nurses' attitudes and comprehension about the prevention of peripheral cannula infections (Bakan & Arli, 2021). This can help healthcare evaluate nurses and provide training according to it. According to the study by Ray-Barruel et al. using the I-DECIDED tool, nurses can increase their ability to identify and manage PIVCs, resulting in better patient outcomes and a safer healthcare environment (Ray-Barruel et al., 2018).

Theory training

Studies demonstrate that different training programs improve the insertion practices. Moreover, focusing on education and training methods illustrates favourable outcomes in clinical practice. Theory and simulation are mixed learning methods used in universities and healthcare centres. Furthermore, it is mandatory to keep patient record, including the date, time, patient details, catheter size, due date of changing the IV (Bahl

et al., 2024). In essence, teaching methods comprise learning projects. Healthcare centers can benefit with the introduction of mixed study methods, incorporating theory and simulation (Hoskins et al., 2023). Through the implementation of teaching interventions that priorities procedures like push-pause, locking, and pulsatile flushing, nurses can effectively lower the rate of problems such as catheter blockage and infiltration (Nunes De Almeida et al., 2022).

Encouraging continuously learning using online courses, seminars and quizzes help students to be on track in the nursing field. Wherefore, Irish education includes hybrid study, which contains theoretical and practical steps. Digital learning environment helps undergraduate students in practices. Nurses' teachers are updating their teaching sessions because they are challenged to prepare students for hospital practices. As a result, they are confronted to teach their students to provide patient safe care. PIVC learning happens online and includes e-learning courses, video-teacher, simulators, virtual reality sessions, video recordings (Hernon et al., 2023).

The clinical practices improve the nursing student's confidence about PIVC. Irregularities between learning and clinical practice may occur. Results say that up to 80% of patients face IV cannulation during hospitalization. This method is successful in reaching vascular access. Statements informed about the importance of educating students regarding the management of PIVC (Massey et al., 2020).

High quality nursing skills are delivered after theory studies have been accomplished. If nurses PIVC performance is low, it means that they didn't receive the necessary training. Therefore, offering advanced education, updated theory and simulation learnings is a key element. Evidence presents the benefit of ultrasound guided PIVC insertion. Nursing care for patients is improved due to educational effects among healthcare staff. Competency assessment is available online for individual nursing testing (Bayoumi et al., 2022).

It is evident that involvement of the teachers in nursing learning has a high effect on students 'competences. Therefore, the Teaching of Understanding (TfU) Framework programme increases educational quality level. Generally, students score better at the theory part and gain good knowledge about anatomy, venous route, and intravenous

treatment. On the contrary, they face challenges in the hospital practice, for example patient safety or aseptic methods (Huang et al., 2024).

Clinical Practice

Worldwide, in hospitals, patients are receiving IV medications. For that reason, effective teaching sessions are implemented for clinical simulation. Various studies show nurses' progression after participating in organized teaching methods. Consistency in teaching training demonstrates positive results among nurses PIVC skills (Bayoumi et al., 2022). Nursing students are guided by a work instructor in their practices when they perform a PIVC insertion. Clinical instruction's role is to make sure that all students gain clinical skills. Development of self-evaluation and communication with the patients are skills obtained through practicing. Education updates should be organized often to ensure minimal complication (Hernon et al., 2023).

Studies identify that teaching of ultrasound guided PIVC insertion expands the nurses' competences. Education presents the principles of ultrasonography. Simulation of how the ultrasound device works is organized. Additionally, learnings about aseptic, treatment, IV insertion, device cleaning methods and documentation are elaborated by academic teachers (Hoskins et al., 2023). It is shown that reduction in healthcare costs impacts quality of PIVC preservation. Patient consent should be achieved prior to PIVC insertion. Nurses' satisfaction rated higher after receiving proper clinical training. Conclusively, they become more effective and motivated to check up on their patients daily (Keogh et al., 2020).

Considerations about the design of clinical instruments have been assigned. It suggested that errors may occur due to deficient devices training among healthcare staff. The purpose is that suitable PIVC devices accessible in healthcare centers should be explored. Studies explained that using a particular PIVC device is adequate to add student's patient safety confidence (Reid-McDermott et al., 2019).

Registered nurses maintain standards in patient care. Competencies obtained from theory and practical knowledge are essential to perform in the healthcare field. Studies confirm that the insertion of a cannula in the vein is a task that demands more practice. Self-confidence and following the instructions are high priorities while doing cannulation procedures. In this matter, nurses master the peripheral cannula insertion with professionalism (Ravik et al., 2017).

Simulation technology is advantageous, because it gives the chance to have access to a diversity of medical methods. Students can visualize internal anatomy on mannequins with the usage of 3-D images or animations. Draw the conclusion, virtual anatomical projections of mannequin arm and vein on where the student can do a PIVC insertion are a good example. Furthermore, it is possible to see latent complications that can happen with the three – dimensional anatomy. Although technology discrepancies may happen, virtual, and mixed reality simulation sessions are seen as successful (Rochlen et al., 2022).

8 ETHICAL PERSPECTIVE

The aim of ethics on research is ensuring responsible and ethical conduct. The purpose is to preserve integrity and credibility, by upholding rights, dignity of research participants. Prioritizing ethical consideration is critical for integrity of the research. Guidelines for research ethics offer a framework for researchers to navigate ethical dilemmas. The principles of causing no harm, avoiding plagiarism, and maintaining honesty, integrity, and accountability (including avoiding falsification and fabrication) are crucial in research (ALLEA - All European Academies, 2023).

This research will be following basic principles according to the European Code of Conduct for Research Integrity. The principles are reliability, honesty, respect and accountability (The Finnish Code of Conduct for Research Integrity in Finland 2023). The thesis will be reflected by using methodology, analysis, and various relevant resources.

Each member doing the research has unique background which brings different perspectives, experiences that enriches the context of the research. Working together with several people can improve the research process' integrity. Peer review, constructive criticism, and quality control are useful in identifying and resolving potential biases or errors in the research design, data collection, and analysis.

During the process of writing the thesis research misconduct criteria guidelines are learned. For the integrity fabrication, falsification and plagiarism are comprehended. Every text, article, material used is referenced and citated (The Finnish Code of Conduct for Research Integrity in Finland 2023).

Researchers follow the University of Applied Science DIAK ethical guidelines, including knowledge of the topic, ethical review, good scientific practice.

9 PROFESSIONAL DEVELOPMENT

Researching peripheral intravenous cannula (PIVC) has helped us learn more about nursing care, from basic principles to advanced techniques. Exploring how to prevent and manage PIVC infections has been interesting and informative. The process includes starting from basic aspects of PIVC and reaching a deeper comprehension of the insertion improvement. Searching for the most advantageous methods in helping nurses with assessment and managing peripheral cannula infection made us curious and fascinated for reading valuable data. We've realized how crucial nurses' role is in patient health. As we learned further about the topic, our appreciation for the importance of PIVC care and aseptic protocols grew. The knowledge acquired from working on this thesis will enhance our professional expertise and be valuable in the workplace.

Throughout the process of working on this thesis, we have developed important skills navigating reliable databases and critically evaluating nursing research. This process not only broadened our understanding of PIVC-related topics. Our academic writing and presentation skills have also seen significant growth. We learned to sift through data and extract information.

10 DISCUSSION

The results highlight how ongoing education benefits nurses and nursing students by improving both their theoretical understanding and practical skills. There are promising opportunities to improve nursing competence in PIVC management using simulation workshops and innovative educational methods including e-learning and multimedia resources. In addition, it becomes clear that following aseptic guidelines and using good hand hygiene are essential components in preventing PIVC infections. The risk of problems can be considerably decreased by using accurate insertion techniques, routine site evaluations, and rapid cannula changes.

These findings are consistent with previous studies, healthcare workers should practice hand hygiene before and after palpating catheter insertion sites, and accessing, repairing, or dressing intravascular catheters, including associated components such as administration sets and access ports (Department of Health & Communicable Diseases Branch, 2018). Focusing on staff PIVC education can enhance nursing knowledge, skills, and confidence, thereby enhancing patient assessment, site selection, aseptic technique, and overall compliance to best practice guidelines for maintaining dressing integrity and recognizing complications. This ultimately improves the quality of patient care provided by healthcare professionals. (K. Glover et al., 2017). E-learning in intravenous cannulation skills training enhances students' readiness for practice and clinical performance and can help them adapt to working life when used in undergraduate training (Carter et al., 2020).

The authors discovered that research in the field was limited after 2020, so they recommend more in-depth research on how to educate and train nurses in PIVC assessment and management to improve patient outcomes and reduce healthcare-associated infections. Additional, for the research is necessary regarding topics including patient education plans, ideal insertion methods, and the effect of new equipment on infection control. Maintaining the highest levels of patient care and safety requires ongoing assessment and development of nursing practices in PIVC treatment. Future research should look at the effectiveness of unique educational programs, evaluate the long-term effects of infection control measures, and learn about the perspectives of patients regarding PIVC care.

Data collected examines nurses' clinical skills in various healthcare departments. Studies are revealing that for nursing students PIVC insertion experiences are different for each clinical placement. In addition, the preferred vein for cannulation is usually the median cubital vein. To be mentioned, for patients with darker skin tones, veins might be difficult to find. Therefore, in this scenario nurses are using an ultrasound device. The use of ultrasound may minimize the risk of extravasation and necessities costs. Furthermore, patient safety and economical aspects are considered. Meaningful elements are deliberated while providing supplies for IV cannulation. Among them should be included the purpose of usage, costs and safety of handling.

Assorted articles are reflecting on the impact of innovative learning upon nurses. For that reason, clinical education is essential for nurses. Learning to utilize prefilled flush syringes contributes to a decrease in PIVC failure rates and other complications. Nurses learning to monitor and assess PIVC continuously is fundamental. Keeping the nursing skills accurate and being curious and attentive requires motivation for learning. Nevertheless, findings recommend that nursing blended learning methods are effective. These include simulations, demonstrations and teaching instructions. Nowadays a strong influence for intellectual studies is gathering various conceptual online information. Consequently, it is obvious that clinical simulations provide confidence and awareness for nursing students.

Education helps minimize cannula infections. Investigations have shown that intensive training, including theory and clinical simulations are important and leads to less cannula infections. To be added that documentation of the cannula insertion is necessary for the patient record. Clinical recommendations present infection prevention guidelines and instructions for students and nurses. Noticeably, nurses' hand hygiene, patient skin disinfection, catheter dressing, securement and needless connector are characteristics associated with the catheter infection. Avoiding multiple attempts in cannula insertion helps in reducing health items costs. Prevention strategies are developed in hospitals regularly. Future research on PIVC infection risks is suggested for clinical decision-making approaches.

Findings present the advantages of skill-trained nurses due to their detailed knowledge and work experience. Additionally, they can share their background and teach new

nurses in establishing the best PIVC insertion. Improving cannula insertion technique happens through daily working practice. Therefore, it is significant for healthcare professionals to be attentive while conducting the procedure. When a catheter is settled correctly in the desired vein with a flashback of blood means that the insertion is successful. Upgrading nursing clinical skills helps in minimizing possible infections. It is remarkable that blended studies stimulate nurses in caring for patients when managing IV therapy. Obviously, an evaluation of nurses learning skills is demanded in hospitals.

Clinical care standards support the quality of patient care and safety environment. Regrettably, not all attempts of PIVC insertion are done correctly. Some patients have veins that aren't easily seen. These patients face more painful symptoms before the cannula is finally settled. They can encounter thrombosis, bruising, treatment delays or sadness. Clearly ultrasonography devices are facilitating IV cannulation and are very useful in certain hospital departments. It is essential to inform the patient on each step of the PIVC procedure. For good measure, supporting the patient and identifying any concerns are part of the nursing process. Furthermore, healthcenters supervisors should verify that nurses have completed the theory and simulation programme prior cannulation methods. In addition, nurses' competences should be evaluated constantly.

11 CONCLUSION

This thesis aimed to find what are the most advantageous methods to help nurses assess and manage peripheral cannula infections. With the research question in mind, this literature study found that nurses can significantly decrease problems related to PIVC use by maintaining hand hygiene, documentation, and continuous monitoring and assessment are essential for effective management. The aim for this thesis is to motivate and allow nurses to reflect on how they manage PIVC in their work.
Furthermore, the research showed that prevention strategies including patient education, strict infection control measures, and collaboration among healthcare providers are essential. Ultimately, continuous learning methods, such as online courses and simulation-blended practices, can improve nurses' performance and patient outcomes.

This thesis benefits patients by receiving safer care. Nurses and students gain skills and confidence in managing PIVC procedures, which leads to providing quality care. Healthcare institutions benefit from cost savings due to decreased expenses related to treating PIVC-related complications

REFERENCES

Abolfotouh, M. A., Salam, M., Bani Mustafa, A., White, D., & Balkhy, H. (2014). Prospective study of incidence and predictors of peripheral intravenous catheter-induced complications. *Therapeutics and Clinical Risk Management*, 993. https://doi.org/10.2147/TCRM.S74685

ALLEA - All European Academies. (2023). *The European Code of Conduct for Research Integrity*. ALLEA - All European Academies. https://doi.org/10.26356/ECoC

Anttila, V.-J. (2024). *Bakteremia, sepsis ja verenmyrkytys*. Duodecim Terveyskirjasto. https://www.terveyskirjasto.fi/dlk00604

Baheti, D. K., & Laheri, V. V. (2018). *Understanding Anesthetic Equipment & Procedures: A Practical Approach*. JP Medical Ltd.

Bahl, A., Mielke, N., Xing, Y., DiLoreto, E., Zimmerman, T., & Gibson, S. M. (2024). A standardized educational program to improve peripheral vascular access outcomes in the emergency department: A quasi-experimental pre-post trial. *The Journal of Vascular Access*, 11297298231219776. https://doi.org/10.1177/11297298231219776

Bakan, A. B., & Arli, S. K. (2021). Development of the peripheral and central venous catheter-related bloodstream infection prevention knowledge and attitudes scale: Nursing in Critical Care. *Nursing in Critical Care*, *26*(1), 35–41. https://doi.org/10.1111/nicc.12422

Barton, A., Vavrik, B. & Ventura, R. (2017). *Peripheral intravenous cannulation: Protecting patients and nurses. British Journal of Nursin*.

Basics of Nursing Practices and Interventions. (n.d.). Retrieved March 8, 2024, from https://is.muni.cz/do/rect/el/estud/lf/js19/osetrovatelske_postupy/web/pages_en/12-zajisteni_zilniho_vstupu.html

Baye, N. D., Teshome, A. A., Ayenew, A. A., Amare, T. J., Mulu, A. T., Abebe, E. C., Tiruneh, G. A., Ayele, T. M., Muche, Z. T., Teklemariam, A. B., Melese, B. D., Agidew, M. M., & Seid, M. A. (2023). Incidence, time to occurrence and predictors of peripheral intravenous cannula-related complications among neonates and infants in Northwest Ethiopia: An institutional-based prospective study. *BMC Nursing*, *22*(1), 11. https://doi.org/10.1186/s12912-022-01164-x

Bayoumi, M. M. M., Khonji, L. M. A., & Gabr, W. F. M. (2022). Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention. *British Journal of Nursing*, *31*(8), S24–S30. https://doi.org/10.12968/bjon.2022.31.8.S24

Beecham, G. B., & Tackling, G. (2024). Peripheral Line Placement. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK539795/

Blanco-Mavillard, I., Rodríguez-Calero, M. Á., de Pedro-Gómez, J., Parra-García, G., Fernández-Fernández, I., & Castro-Sánchez, E. (2019). Incidence of peripheral intravenous catheter failure among inpatients: Variability between microbiological data and clinical signs and symptoms. *Antimicrobial Resistance & Infection Control*, *8*(1), 124. https://doi.org/10.1186/s13756-019-0581-8

Carter, H., Hanks, S., & Gale, T. (2020). A qualitative study using hybrid simulation to explore the impacts of human factors e-learning on behaviour change. *Advances in Simulation*, *5*, 20. https://doi.org/10.1186/s41077-020-00136-y

Catarino, F., Lourenço, C., Correia, C., Dória, J., Dixe, M., Santos, C., Sousa, J., Mendonça, S., Cardoso, D., & Costeira, C. R. (2022). Nursing Care in

Peripheral Intravenous Catheter (PIVC): Protocol of a Best Practice Implementation Project. *Nursing Reports*, *12*(3), 515–519. https://doi.org/10.3390/nursrep12030049

Communicable Diseases Act, 1227 (2016). https://www.finlex.fi/en/laki/kaannokset/2016/en20161227.pdf

Conduct a literature review, 2024. (n.d.). Retrieved May 2, 2024, from https://lib.arizona.edu/research/write-cite/lit-review

Cooke, M., Ullman, A. J., Ray-Barruel, G., Wallis, M., Corley, A., & Rickard, C. M. (2018). Not "just" an intravenous line: Consumer perspectives on peripheral intravenous cannulation (PIVC). An international cross-sectional survey of 25 countries. *PLoS ONE*, *13*(2), e0193436. https://doi.org/10.1371/journal.pone.0193436

de Sousa Salgueiro-Oliveira, A., Lima Basto, M., Muniz Braga, L., Arreguy-Sena, C., Nakahara Melo, M., & dos Santos Dinis Parreira, P. M. (2019). Nursing Practices in Peripheral Venous Catheter: Phlebitis and Patient Safety: Texto & Contexto Enfermagem. *Texto & Contexto Enfermagem*, *28*, 1–13. https://doi.org/10.1590/1980-265X-TCE-2018-0109

Department of Health & Communicable Diseases Branch. (2018). *Guideline, Peripheral intravenous catheter (PIVC)*. https://www.health.qld.gov.au/__data/assets/pdf_file/0025/444490/icare-pivc-guideline.pdf

Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine*, *7*(3), 93–99. https://doi.org/10.1016/j.afjem.2017.08.001

ETHICAL RECOMMENDATIONS FOR THESIS WRITING AT UNIVERSITIES OF APPLIED SCIENCES_2020.pdf. (n.d.). Retrieved March 3, 2024, from

https://www.arene.fi/wp-content/uploads/Raportit/2020/ETHICAL%20RECOMMENDATIONS%20FOR%20THESIS%20WRITING%20AT%20UNIVERSITIES%20OF%20APPLIED%20SCIENCES_2020.pdf?_t=1578480382

FINLEX ® - Säädökset alkuperäisinä: Laki terveydenhuollon laitteista ja tarvikkeista… 720/2021. (n.d.). Oikeusministeriö. Retrieved March 8, 2024, from https://finlex.fi/fi/laki/alkup/2021/20210720

García-Expósito, J., Reguant, M., Canet-Vélez, O., Ruiz Mata, F., Botigué, T., & Roca, J. (2021). Evidence of learning on the insertion and care of peripheral venous catheters in nursing students: A mixed study. *Nurse Education Today*, *107*, 105157. https://doi.org/10.1016/j.nedt.2021.105157

Gibian, J. T., Zakria, D., March, C., Schaheen, B., & Drolet, B. C. (2022). Outcomes and Management of Peripheral Intravenous Infiltration Injuries. *Hand (New York, N.Y.)*, *17*(1), 148–154. https://doi.org/10.1177/1558944720906494

Gil, A. (2015). The Role of the Internet in Self-Study. *SOCIETY, INTEGRATION, EDUCATION. Proceedings of the International Scientific Conference*, *4*, 393. https://doi.org/10.17770/sie2015vol4.398

Glover, K. R., Stahl, B. R., Murray, C., LeClair, M., Gallucci, S., King, M. A., Labrozzi, L. J., Schuster, C., & Keleekai, N. L. (2017). Simulation 2017. *The Journal of Continuing Education in Nursing*, *48*(9), 397–406. https://doi.org/10.3928/00220124-20170816-05

Glover, K., Stahl, B., Murray, C., Leclair, M., Gallucci, S., King, M., Labrozzi, L., Schuster, C., & Keleekai-Brapoh, N. (2017). A Simulation-Based Blended Curriculum for Short Peripheral Intravenous Catheter Insertion: An Industry–Practice Collaboration. *The Journal of Continuing Education in Nursing*, *48*, 397–406. https://doi.org/10.3928/00220124-20170816-05

Guanche-Sicilia, A., Sánchez-Gómez, M. B., Castro-Peraza, M. E., Rodríguez-Gómez, J. Á., Gómez-Salgado, J., & Duarte-Clíments, G. (2021). Prevention and Treatment of Phlebitis Secondary to the Insertion of a Peripheral Venous Catheter: A Scoping Review from a Nursing Perspective. *Healthcare*, *9*(5), 611. https://doi.org/10.3390/healthcare9050611

Helsinki, A. O. M. 7 00250. (n.d.). *Venflon Pro suonikanyyli*. Retrieved March 8, 2024, from https://2016061102.vilkasstore.com/Venflon-Pro-suonikanyyli

Hernon, O., McSharry, E., Simpkin, A., MacLaren, I., & Carr, P. J. (2023). Effectiveness of structured self-evaluation of video recorded performance on peripheral intravenous catheter insertion: A randomised control trial study protocol. *Trials*, *24*(1), 182. https://doi.org/10.1186/s13063-023-07200-8

Hoitoon liittyvien infektioiden torjunta 2024. (n.d.). Retrieved March 16, 2024, from https://www.hus.fi/sites/default/files/2022-02/Aseptiikka%20ja%20infektioiden%20torjunta%20perifeerisen%20kanyylin%20hoidossa%20aikuisella.pdf

Hoskins, M. J., Nolan, B. C., Evans, K. L., & Phillips, B. (2023). Educating health professionals in ultrasound guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes. *Medicine*, *102*(16), e33624. https://doi.org/10.1097/MD.0000000000033624

Høvik, L. H., Gjeilo, K. H., Lydersen, S., Rickard, C. M., Benedikte Røtvold, Damås, J. K., Solligård, E., & Gustad, L. T. (2019). Monitoring quality of care for peripheral intravenous catheters; feasibility and reliability of the peripheral intravenous catheters mini questionnaire (PIVC-miniQ): BMC Health Services Research. *BMC Health Services Research*, *19*(1), N.PAG-N.PAG. https://doi.org/10.1186/s12913-019-4497-z

Huang, J., Liu, X., Xu, J., Ren, L., Liu, L., Jiang, T., Huang, M., & Wu, Z. (2024). Examining the effect of training with a teaching for understanding framework on intravenous therapy administration's knowledge, performance, and satisfaction of nursing students: A non-randomized controlled study. *BMC Nursing*, *23*(1), 104. https://doi.org/10.1186/s12912-024-01783-6

HUS. (n.d.). Retrieved March 10, 2024, from https://www.hus.fi/sites/default/files/2022-01/Aseptiikka%20ja%20infektioiden%20torjunta%20perifeerisen%20kanyylin%20hoidossa%20aikuisella.pdf

Kanyylin juuren ihon arviointi aikuisilla (VIP-score).pdf. (n.d.). Retrieved March 8, 2024, from https://www.hus.fi/sites/default/files/2023-05/Kanyylin%20juuren%20ihon%20arviointi%20aikuisilla%20%28VIP-score%29.pdf

Keogh, S., Shelverton, C., Flynn, J., Mihala, G., Mathew, S., Davies, K. M., Marsh, N., & Rickard, C. M. (2020). Implementation and evaluation of short peripheral intravenous catheter flushing guidelines: A stepped wedge cluster randomised trial. *BMC Medicine*, *18*(1), 252. https://doi.org/10.1186/s12916-020-01728-1

Kettunen, R. (2020). *Laskimotukos (laskimoveritulppa)*. Duodecim Terveyskirjasto. https://www.terveyskirjasto.fi/dlk00039

Korkut, S., Guler, S., Zincir, H., Yilmaz, D., & Avcil, K. (2022). Experiences and Observations of Nurses Regarding Dislodgement of Peripheral Venous Catheters: International Journal of Caring Sciences. *International Journal of Caring Sciences*, *15*(2), 1353–1362.

Kyngäs, H., Mikkonen, K., & Kääriäinen, M. (2019). *The Application of Content Analysis in Nursing Science Research*. Springer Nature.

Laskimokanyylit. Sh Oskar Nyholm—PDF Ilmainen lataus. (n.d.). Retrieved March 9, 2024, from https://docplayer.fi/127761509-Laskimokanyylit-sh-oskar-nyholm.html

Lee, M. M., Anand, S., & Loyd, J. W. (2024). Saphenous Vein Cutdown. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK532880/

Leite, D. F. B., Padilha, M. A. S., & Cecatti, J. G. (2019). Approaching literature review for academic purposes: The Literature Review Checklist. *Clinics*, *74*, e1403. https://doi.org/10.6061/clinics/2019/e1403

Lockwood, C., Munn, Z., & Porritt, K. (2015). Qualitative research synthesis: Methodological guidance for systematic reviewers utilizing meta-aggregation. *International Journal of Evidence-Based Healthcare*, *13*. https://doi.org/10.1097/XEB.0000000000000062

Mandal, A., & Raghu, K. (2019). Study on incidence of phlebitis following the use of pherpheral intravenous catheter. *Journal of Family Medicine and Primary Care*, *8*(9), 2827–2831. https://doi.org/10.4103/jfmpc.jfmpc_559_19

Marsh, N., Larsen, E. N., Takashima, M., Kleidon, T., Keogh, S., Ullman, A. J., Mihala, G., Chopra, V., & Rickard, C. M. (2021). Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. *International Journal of Nursing Studies*, *124*, 104095. https://doi.org/10.1016/j.ijnurstu.2021.104095

Marsh, N., Larsen, E. N., Ullman, A. J., Mihala, G., Cooke, M., Chopra, V., Ray-Barruel, G., & Rickard, C. M. (2024). Peripheral intravenous catheter infection and failure: A systematic review and meta-analysis. *International Journal of Nursing Studies*, *151*, 104673. https://doi.org/10.1016/j.ijnurstu.2023.104673

Marsh, N., Webster, J., Mihala, G., & Rickard, C. M. (2015). Devices and dressings to secure peripheral venous catheters to prevent complications. *The Cochrane*

Database of Systematic Reviews, *2015*(6), CD011070. https://doi.org/10.1002/14651858.CD011070.pub2

Massey, D., Craswell, A., Ray-Barruel, G., Ullman, A., Marsh, N., Wallis, M., & Cooke, M. (2020). Undergraduate nursing students' perceptions of the current content and pedagogical approaches used in PIVC education. A qualitative, descriptive study. *Nurse Education Today*, *94*, 104577. https://doi.org/10.1016/j.nedt.2020.104577

Mewahegn, A. A., Tadesse, B., GebreEyesus, F. A., Tarekegn, T. T., Amlak, B. T., Emeria, M. S., Temere, B. C., Terefe, T. F., Zewudie, B. T., Geletie, H. A., & Mengist, S. T. (2022). Lifespan and Associated Factors of Peripheral Intravenous Cannula Among Hospitalized Children in Public Hospitals of the Gurage Zone, Ethiopia, 2021. *Pediatric Health, Medicine and Therapeutics*, *13*, 81–93. https://doi.org/10.2147/PHMT.S351759

Milutinović, D., Simin, D., & Zec, D. (2015). Risk factor for phlebitis: A questionnaire study of nurses' perception. *Revista Latino-Americana de Enfermagem*, *23*(4), 677–684. https://doi.org/10.1590/0104-1169.0192.2603

Munoz-Mozas, G. (2023). Preventing intravenous catheter-related bloodstream infections (CRBSIs): British Journal of Nursing. *British Journal of Nursing*, *32*(Sup7), S4–S10. https://doi.org/10.12968/bjon.2023.32.Sup7.S4

Nancy L. Moureau. (2019). *Vessel health and preservation: The right approach for vascular access*.

Nickel, B. (2019). Peripheral Intravenous Access: Applying Infusion Therapy Standards of Practice to Improve Patient Safety: Critical Care Nurse. *Critical Care Nurse*, *39*(1), 61–71. https://doi.org/10.4037/ccn2019790

Nickel, B. (2020). Hiding in Plain Sight: Peripheral Intravenous Catheter Infections: Critical Care Nurse. *Critical Care Nurse*, *40*(5), 57–66. https://doi.org/10.4037/ccn2020439

Nunes De Almeida, A. C., Herculina Pires, M., De Souza Santana, I., De Oliveira Salgado, P., Vieira Toledo, L., Parreira, P., & Muniz Braga, L. (2022). EFFECTIVENESS OF AN EDUCATIONAL INTERVENTION FOR THE PREVENTION OF PERIPHERAL VENOUS CATHETER COMPLICATIONS. *Cogitare Enfermagem*, *27*, 1–13. https://doi.org/10.5380/ce.v27i0.87276

Nursing guidelines: Peripheral intravenous (IV) device management. (n.d.). Retrieved March 8, 2024, from https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/peripheral_intravenous_iv_device_management/#assessment

O'Grady, N. P., Alexander, M., Burns, L. A., Dellinger, E. P., Garland, J., Heard, S. O., Lipsett, P. A., Masur, H., Mermel, L. A., Pearson, M. L., Raad, I. I., Randolph, A. G., Rupp, M. E., Saint, S., & the Healthcare Infection Control Practices Advisory Committee (HICPAC) (Appendix 1). (2011). Summary of Recommendations: Guidelines for the Prevention of Intravascular Catheter-related Infections. *Clinical Infectious Diseases*, *52*(9), 1087–1099. https://doi.org/10.1093/cid/cir138

O'Grady, N. P., Alexander, M., Dellinger, E. P., Gerberding, J. L., Heard, S. O., Maki, D. G., Masur, H., McCormick, R. D., Mermel, L. A., Pearson, M. L., Raad, I. I., Randolph, A., & Weinstein, R. A. (2002). Guidelines for the Prevention of Intravascular Catheter–Related Infections. *Clinical Infectious Diseases*, *35*(11), 1281–1307. https://doi.org/10.1086/344188

Osti, C., Khadka, M., Wosti, D., Gurung, G., & Zhao, Q. (2019). Knowledge and practice towards care and maintenance of peripheral intravenous cannula among nurses in Chitwan Medical College Teaching Hospital, Nepal. *Nursing Open*, *6*(3), 1006–1012. https://doi.org/10.1002/nop2.288

Paré, G., & Kitsiou, S. (2017). Chapter 9 Methods for Literature Reviews. In *Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]*. University of Victoria. https://www.ncbi.nlm.nih.gov/books/NBK481583/

Patino, C. M., & Ferreira, J. C. (2018). Inclusion and exclusion criteria in research studies: Definitions and why they matter. *Jornal Brasileiro de Pneumologia*, *44*(2), 84. https://doi.org/10.1590/S1806-37562018000000088

Perifeerisen laskimokatetrin asettaminen ja käsittely—THL. (2023, December 7). Terveyden ja hyvinvoinnin laitos. https://thl.fi/aiheet/infektiotaudit-ja-rokotukset/taudit-ja-torjunta/infektioiden-ehkaisy-ja-torjuntaohjeita/infektioiden-ehkaisy-eri-hoitotoimenpiteissa/perifeerisen-laskimokatetrin-asettaminen-ja-kasittely

Peripheral Line Placement, 2023. (n.d.). Retrieved March 8, 2024, from https://www.ncbi.nlm.nih.gov/books/NBK539795/#:~:text=Peripheral%20intravenous%20(IV)%20lines%2C,directly%20into%20a%20peripheral%20vein.

Peripheral Line Placement—StatPearls—NCBI Bookshelf. (2023). https://www.ncbi.nlm.nih.gov/books/NBK539795/#:~:text=Peripheral%20intravenous%20(IV)%20lines%2C,directly%20into%20a%20peripheral%20vein.

Pohjois-pohjanmaan sairaanhoitopiiri. (n.d.).

Potilashoidon kirjaamisen tarkoitus ja sisältö—Duodecim Oppiportti. (n.d.). Retrieved March 7, 2024, from

https://www.oppiportti.fi/op/aop00309/do?p_haku=dokumentointi#q=dokumentointi

Purssell, E. (2017). Preventing infection in intravenous catheters in the community: British Journal of Community Nursing. *British Journal of Community Nursing*, *22*(8), 374–377. https://doi.org/10.12968/bjcn.2017.22.8.374

Rai, A., Khera, A., Jain, M., Krishnakumar, M., & Sreevastava, D. K. (2019). Bacterial colonization of peripheral intravenous cannulas in a tertiary care hospital: A cross sectional observational study. *Medical Journal, Armed Forces India*, *75*(1), 65–69. https://doi.org/10.1016/j.mjafi.2018.04.004

Ravik, M., Havnes, A., & Bjørk, I. T. (2017). *Conditions Affecting the Performance of Peripheral Vein Cannulation during Hospital Placement: A Case Study*. https://www.hindawi.com/journals/nrp/2017/9748492/

Ray-Barruel, G. (2017). Infection Prevention: Peripheral Intravenous Catheter Assessment and Care: Australian Nursing & Midwifery Journal. *Australian Nursing & Midwifery Journal*, *24*(8), 34–34.

Ray-Barruel, G., Cooke, M., Mitchell, M., Chopra, V., & Rickard, C. M. (2018). Implementing the I-DECIDED clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: Protocol for an interrupted time-series study. *BMJ Open*, *8*(6), e021290. https://doi.org/10.1136/bmjopen-2017-021290

Ray-Barruel, G., Xu, H., Marsh, N., Cooke, M., & Rickard, C. M. (2019). Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review. *Infection, Disease & Health*, *24*(3), 152–168. https://doi.org/10.1016/j.idh.2019.03.001

Reid-McDermott, B., Browne, M., Byrne, D., O'Connor, P., O'Dowd, E., Walsh, C., Madden, C., & Lydon, S. (2019). Using simulation to explore the impact of device design on the learning and performance of peripheral intravenous cannulation. *Advances in Simulation*, *4*(1), 27. https://doi.org/10.1186/s41077-019-0118-5

Rochlen, L. R., Putnam, E., Levine, R., & Tait, A. R. (2022). Mixed reality simulation for peripheral intravenous catheter placement training. *BMC Medical Education*, *22*(1), 876. https://doi.org/10.1186/s12909-022-03946-y

Salameh, M. A., Shatarat, A. T., Badran, D. H., Abu-Abeeleh, M. A., Massad, I. M., & Bani-Hani, A. M. (2019). The best vein to be accessed based on descriptive study of dorsal metacarpal vein. *Anatomy & Cell Biology*, *52*(4), 390–396. https://doi.org/10.5115/acb.19.142

Schmutz, A., Menz, L., Schumann, S., & Heinrich, S. (2020). Dislodgement Forces and Cost Effectiveness of Dressings and Securement for Peripheral Intravenous Catheters: A Randomized Controlled Trial. *Journal of Clinical Medicine*, *9*(10), 3192. https://doi.org/10.3390/jcm9103192

Sharma, M., Paudel, S., Shrestha, U., & Sitaula, B. (2022a). Knowledge of Intravenous Cannulation among Interns of a Teaching Hospital: A Descriptive Cross-sectional Study. *JNMA: Journal of the Nepal Medical Association*, *60*(247), 290–293. https://doi.org/10.31729/jnma.7222

Sharma, M., Paudel, S., Shrestha, U., & Sitaula, B. (2022b). Knowledge of Intravenous Cannulation among Interns of a Teaching Hospital: A Descriptive Cross-sectional Study. *JNMA: Journal of the Nepal Medical Association*, *60*(247), 290–293. https://doi.org/10.31729/jnma.7222

Sr. Litty Sh, Sr. T. Nc., & Rani, Dr. S. R. (2021). KNOWLEDGE AND PRACTICE ON IV CANNULATION AMONG NURSES. *IDC International Journal*, *8*(1). https://doi.org/10.47211/idcij.2021.v08i01.008

The Finnish code of conduct for research integrity and procedures for handling alleged violations of research integrity in Finland 2023. (n.d.).

The Office of Reasearch Integrity. (n.d.). *Responsible Conduct in Data Managment*. https://ori.hhs.gov/education/products/n_illinois_u/datamanagement/dctopic.html

THL - Perifeerisen laskimokatetrin asettaminen ja käsittely. (2023, December 7). Terveyden ja hyvinvoinnin laitos. https://thl.fi/aiheet/infektiotaudit-ja-rokotukset/taudit-ja-torjunta/infektioiden-ehkaisy-ja-torjuntaohjeita/infektioiden-ehkaisy-eri-hoitotoimenpiteissa/perifeerisen-laskimokatetrin-asettaminen-ja-kasittely

Thomas, C., Cabilan, C. J., & Johnston, A. N. B. (2020). Peripheral intravenous cannula insertion and use in a tertiary hospital emergency department: A cross-sectional study. *Australasian Emergency Care*, *23*(3), 166–172. https://doi.org/10.1016/j.auec.2020.02.001

Toney-Butler, T. J., & Unison-Pace, W. J. (2024). Nursing Admission Assessment and Examination. In *StatPearls*. StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK493211/

Winchester, C. L., & Salji, M. (2016). Writing a literature review. *Journal of Clinical Urology*, *9*(5), 308–312. https://doi.org/10.1177/2051415816650133

Yasuda, H., Yamamoto, R., Hayashi, Y., Kotani, Y., Kishihara, Y., Kondo, N., Sekine, K., Shime, N., Morikane, K., Abe, T., Takebayashi, T., Maeda, M., Shiga, T., Furukawa, T., Inaba, M., Fukuda, S., Kurahashi, K., Murakami, S., Yasumoto, Y., … on behalf of the AMOR-VENUS study group. (2021). Occurrence and

incidence rate of peripheral intravascular catheter-related phlebitis and complications in critically ill patients: A prospective cohort study (AMOR-VENUS study). *Journal of Intensive Care*, *9*(1), 3. https://doi.org/10.1186/s40560-020-00518-4

Zhang, L., Cao, S., Marsh, N., Ray-Barruel, G., Flynn, J., Larsen, E., & Rickard, C. M. (2016). Infection risks associated with peripheral vascular catheters. *Journal of Infection Prevention*, *17*(5), 207–213. https://doi.org/10.1177/1757177416655472

Zingg, W., Barton, A., Bitmead, J., Eggimann, P., Pujol, M., Simon, A., & Tatzel, J. (2023). Best practice in the use of peripheral venous catheters: A scoping review and expert consensus. *Infection Prevention in Practice*, *5*(2), 100271. https://doi.org/10.1016/j.infpip.2023.100271

APPENDIX 1. Summary table.

Article no.	Author(s)/Year /Country	Article title	Study aim	Method (intervention)	Results
1	Abolfotouh, M. A., et al. (2014) Saudi Arabia.	Prospective study of incidence and predictors of peripheral intravenous catheter-induced complications.	To assess the pattern and complications of PIVCs at King Abdulaziz Medical City (KAMC) in Saudi Arabia.	An observational prospective cohort study, in which the incidence of PIVCs phlebitis and other complications was assessed periodically on 12-hour intervals up to 96 hours after insertion.	The study found higher complication rates than previous studies, suggesting improved insertion techniques to extend PIVC onset beyond day 3 and routine catheter changes.
2	Bahl, A., Mielke, N., et al. (2024) Wisconsin, USA	A standardized educational program to improve peripheral vascular access outcomes in the emergency department: A quasi-experimental pre-post-trial.	To improve the difficult intravenous access by organizing vascular access training	Quasi-experimental pre-post interventional study conducted in emergency department, including 1100 hospital beds.	It addresses the challenges faced by patients and the need for improvement of peripheral vascular access.
3	Bakan, A. B., & Arli, S. K. (2021) Turkey	Development of the peripheral and central venous catheter-related bloodstream infection prevention knowledge and attitudes scale	To create a scale to assess nurses' knowledge and attitudes	Methodological study, 150 nurses working in different clinics in hospitals located in two different cities in the eastern part of Turkey	It provides a comprehensive tool for evaluating nurses' competencies in infection prevention measures related to catheter care

4	Bayoumi, M., et al. (2022) Bahrain	Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention	To explore nurses' theoretical knowledge and transfer into clinical practice	A quasi-experimental research design done using semi-structured questionnaire. Surgical and medical ward with 64 nurses	Post-intervention there was significant improvement in technique and assessment knowledge
5	Blanco-Mavillard, I., et al. (2022) Spain	What fuels suboptimal care of peripheral intravenous catheter-related infections in hospitals? A qualitative study of decision-making among Spanish nurses.	To investigate the determinants of PIVC-BSI prevention decision-making among nurses in Spanish hospitals.	Descriptive qualitative study using semi structured interviews in three public hospitals in Spain	Clinical management of PIVCs is unclear, fragmented, and lacks clear professional responsibility. This results in a gap in infection prevention and lack of adherence to evidence requiring facilitation strategies.
6	de Sousa Salgueiro-Oliveira, et al. (2019) Portugal	Nursing Practices in Peripheral Venous Catheter: Phlebitis and Patient Safety	To access nursing practices and identify if clinical practices are implemented properly	Qualitative study done by observation techniques and semi-structured interviews with 26 and 13 nurses	The study discovered gaps in nursing practices for phlebitis prevention, which were caused by institutional factors and a lack of knowledge.
7	Gabr, M., et al. (2022) USA	Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention	Preventing issues of IV therapy by shifting knowledge into action.	A quasi-experimental study organized in surgical and medical ward, established nurses' knowledge, care and practice of PVC.	Clinical practice and knowledge improvement through constant education. Nurses monitoring and assessment of PIVC.

8	Hernon, O., et al. (2023) Ireland	Effectiveness of structured self-evaluation of video recorded performance on peripheral intravenous catheter insertion	Innovative teaching, for e.g. online reality using video for students to help them achieve confident clinical psychomotor skills.	Control trial study that adds value to nursing students' clinical performance and comprehension.	An evaluation of PIVC simulation performance which influences students' confidence and clinical ability.
9	Hoskins, M. J., Nolan, B. C., Evans, K. L., & Phillips, B. (2023)	Educating health professionals in ultrasound guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes.	Ultrasound supervised PIVC procedures, demonstrates ultrasonography being cautious and successful while processing insertion for patients.	Systematic review about teaching sessions for healthcare staff to facilitate the ultrasound guided PIVC clinical skill.	Innovative teaching of ultrasound guided PIVC insertion upgrade nurses learning motivation, critical clinical skills and helps minimize the risk of barriers among patients.
10	Høvik, L. H., et al. (2019) Mid-Norway	Monitoring quality of care for peripheral intravenous catheters; feasibility and reliability of the peripheral intravenous catheter's mini questionnaire (PIVC-miniQ)	To design and test the viability and validity of a quality evaluation tool for overall PIVC quality, addressing weaknesses in best practices to avoid catheter-associated bloodstream infections.	Research article. PIVC-mini-Questionnaire, consisting of 16 items assessing problems related to insertion site, dressing and equipment condition, documentation, and indication for use.	The study highlights the need for PIVC quality surveillance at both the ward and hospital levels. The PIVC-miniQ is described as a dependable and time-efficient instrument for conducting regular point-prevalence audits to identify deficiencies to prevent CABSI.

11	Huang, J., Liu, X., Xu, J., Ren, L., Liu, L., Jiang, T., Huang, M., & Wu, Z. (2024) China	Examining the effect of training with a teaching for understanding framework on intravenous therapy administration's knowledge, performance, and satisfaction of nursing students: A non-randomized controlled study.	Strengthening teaching learning operation and contribution to nursing students' education in IV insertions.	Sampling methodology directed in a surgery section from university hospital in China with the participation of 102 nursing students.	It focuses on learning satisfaction, communication, teamwork, working environment, social understanding, competences, and nurses learning concerns.
12	Keogh, S., Shelverton, C., et al. (2020). Queensland, Australia	Implementation and evaluation of short peripheral intravenous catheter flushing guidelines: A stepped wedge cluster randomized trial.	Consideration and effectiveness of clinical education helps reduce possible complications and patient pain.	Control trial implemented with patients from general medical and surgical hospital wards	A variety of clinical education for nurses and complementary supplies for e.g. pre-filled flush syringes contributes to a decrease of PIVC failure and risk interventions.
13	Korkut, S., et al. (2022) Turkey	Experiences and Observations of Nurses Regarding Dislodgement of Peripheral Venous Catheters	The purpose of this research is to explore nurses' experiences and observations on factors associated with partial or total dislodgement of PIVC	A questionnaire created by the researchers was used to gather data from 297 nurses who met the inclusion criteria and consented to participate	The study identifies partial or complete dislodgement of PIVCs as a significant issue leading to PIVC failure. It highlights the importance of precautions.

14	Marsh, N., Larsen, E. N., et al. (2023) Queensland, Australia	Safety and efficacy of midline catheters versus peripheral intravenous catheters	The aim is to test and compare by nursing clinical practices the safety of midline catheters and peripheral intravenous catheters on patients.	Study design and ethical considerations conducted in medical/surgical wards with the observation of device insertion and maintenance.	The findings explain possible cost savings for the hospitals and health assistance involved by using less products and saving staff timing to insert different devices.
15	Marsh, N., et al. (2015).	Devices and dressings to secure peripheral venous catheters to prevent complications	To assess the effects of different dressings and securement devices on the incidence of PIVC failure	systematic review of randomized controlled trials or cluster randomized trails. Trails from Spain, Italy, England, USA hospitals	The study had low quality evidence on what is the most effective way to secure PIVC.
16	Massey, D., Craswell, et al. (2020) Queensland, Australia	Undergraduate nursing students' perceptions of the current content and pedagogical approaches used in PIVC education	Exploring critically the PIVC training for students from their own point of view.	Qualitative study based on semi-structured interviews with third year students.	Clinical simulations offer trust and confidence for nursing students. Learnings should be done continuously to keep the skills accurate.
17	Munoz-Mozas, G. (2023) England	Preventing intravenous catheter-related bloodstream infections (CRBSIs).	To put pieces together to give a clearer picture and provide various solutions to prevent CRBSI.	A literature review about catheter-related bloodstream infections (CRBSIs)	IV catheter placement is crucial for patient care, but risks include hand hygiene, disinfection, and proper maintenance. Regular education, quality improvement interventions, and

					adherence to best practices are essential.
18	Nickel, B. (2019). USA	Peripheral Intravenous Access: Applying Infusion Therapy Standards of Practice to Improve Patient Safety.	To examine the delivery of high-quality PIV access care through the application of relevant infusion therapy practice standards and evidence passed guidelines.	A case study approach with 3 different case studies.	Evidence-based nursing applies validated knowledge to optimize patient outcomes, including peripheral intravenous-site management.
19	Nickel, B. (2020) USA	Hiding in Plain Sight: Peripheral Intravenous Catheter Infections.	This article reviews the burden of peripheral venous catheter infections and current evidence-based recommendations for prevention.	A literature review.	PIVC is a danger to patient's healthcare settings, with higher than suspected rates of PIVCR-BSIs leading to significant morbidity and mortality, increased cost, and reduced patient satisfaction.
20.	Nunes De Almeida, A. C., (2022). Brazil	Effectiveness of an educational intervention for the prevention of peripheral venous catheter complications	To evaluate the impact of an educational intervention on nursing practices related to PIVC and to assess its´ effect on the incidence of complications.	Observational study from two groups. Pre-intervention group of 75 patients and post-intervention group of 68 patients. Educational intervention for 78 nurses to practice flush, push-pause and locking techniques	The adoption of flushing, push-pause, and locking techniques, leading to a significant decrease in PIVC obstruction. Practices and education. Better understanding and ongoing education improved nursing

					practices and health outcomes.
21	Oren, B., & Cuvadar, A. (2020) Turkey	The Effectiveness of Training for Peripheral Venous Catheter Application in Intensive Care Units of a University Hospital: International Journal of Caring Sciences	To assess the effectiveness of structured education on the behavior of nurses regarding PIVC application	30- question, questionnaire done with 58 nurses. 30 in the study group and 28 in the control group. The study group was also given 60-minute training to evaluate the effectiveness of the education compared to control group.	The study group benefited significantly from training about PIVC management, but a single session was insufficient to bring about a complete behavioral shift. Regular in-service training and guidelines is needed.
22	Purssell, E. (2017).	Preventing infection in intravenous catheters in the community.	This article reviews methods and practices to prevent intravenous catheter infections in community nursing homes.	A literature review.	The rise in community patients with IV devices brings infection risks. Guidance on safe management emphasizes individualized care aligned with best practices. Evaluation of evidence strength is crucial for informed decision-making.
23	Ray-Barruel, G. (2017).	Infection Prevention: Peripheral Intravenous Catheter Assessment and Care.	This article provides guidelines for preventing peripheral venous catheter (PIVC) infections.	A literature review	Importance of assessing IV catheters, preventing complications.

24	Ray-Barruel, G., et al. (2018)	Implementing the I-DECIDED clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: protocol for an interrupted time-series study	This study evaluates the effectiveness of the I-DECIDED assessment and decision-making tool in clinical practice in timely removal of PIVC and early detection of complications.	Prospective study with mixed methods, including stakeholders' consultation and data analysis.	The text highlights the issue of unnecessary retention of PIVCs and premature failure, advocating for structured approach like I-DESIDED tool for IV assessment and decision making.
25	Ray-Barruel, G., et al. (2019)	Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital patients: A systematic review.	The point of this paper is to synthesize proof on the viability of PIVC addition and upkeep bundles on avoiding unfavorable occasions.	Systematic review, that looked numerous electronic databases, trial registries, and dim writing for qualified ponders distributed in English to recognize intercession ponders assessing PIVC inclusion or support bundles with two or more components.	The impact of PIVC bundles on PIVC complications and circulatory system disease rates remains questionable. Institutionalization of bundle components and more thorough studies are required.
26	Reid-McDermott, B., et al. (2019) Ireland	Using simulation to explore the impact of device design on the learning and performance of peripheral intravenous cannulation.	Observing different medical equipment of learning and their impact while performing PIVC in hospitals.	Experimental design organized in the National University of Ireland Galway's simulation laboratory.	The conclusion informs that devices should carefully being used while they are available in the clinical simulation for students.

27	Rochlen, L. R., Putnam, E., Levine, R., & Tait, A. R. (2022) Michigan, USA	Mixed reality simulation for peripheral intravenous catheter placement training.	Evaluation of mixed reality simulation project with 3-D virtual anatomical project images for e.g. images of arm and vein to settle a PIVC in a mannequin arm.	A program consisting of projected images, including anatomy of the arm veins and follow-up by surveys. Qualitative data has been included.	This procedural study is ideal for the participants to become knowledgeable and aware of the potential PIVC complications.
28	Simões, A. M. N.,et al. (2022).	Risk factors for peripheral intravenous catheter-related phlebitis in adult patients	To identify risk factors for PIVC-related phlebitis in adult patients	Randomized clinical trial involving 1,319 patients	Reduced mobility, a family history VTE, inserting a PIVC in the hand's back veins, pain experienced during PIVC insertion, and using some drugs were found to be significant risk factors for the development of phlebitis
29	Webster, J., et al. (2019) Australia & New Zealand	Clinically indicated replacement versus routine replacement of peripheral venous catheters	To evaluate whether routine replacement of PIVC is necessary compared to removal only when clinically indicated.	A systematic review of randomized controlled trials	The study found moderate evidence indicating routine replacement may not be necessary as it doesn't significantly reduce the risk of phlebitis or bloodstream infection.
30	Zhang, L., et al. (2016) UK	Infection risks associated with	This article describes the sources and routes of PIVC-	A narrative review of studies describing the infection risks	PIVCs in hospitals pose a high risk of bloodstream

		peripheral vascular catheters.	associated infections and discusses known effective prevention and intervention strategies.	associated with PIVCs.	infection, an under-evaluated issue compared to central catheters. Future studies on PIVC-associated infection risks are necessary for clinical decision-making.

APPENDIX 2. Chosen 30 articles

1. Abolfotouh, M. A., Salam, M., Bani Mustafa, A., White, D., & Balkhy, H. (2014). Prospective study of incidence and predictors of peripheral intravenous catheter-induced complications. *Therapeutics and Clinical Risk Management*, 993. https://doi.org/10.2147/TCRM.S74685

2. Bahl, A., Mielke, N., Xing, Y., DiLoreto, E., Zimmerman, T., & Gibson, S. M. (2024). A standardized educational program to improve peripheral vascular access outcomes in the emergency department: A quasi-experimental pre-post trial. *The Journal of Vascular Access*, 11297298231219776.Abolfotouh, M. A., Salam, M., Bani Mustafa, A., White, D., & Balkhy, H. (2014). Prospective study of incidence and predictors of peripheral intravenous catheter-induced complications. *Therapeutics and Clinical Risk Management*, 993. https://doi.org/10.2147/TCRM.S74685

3. Bakan, A. B., & Arli, S. K. (2021). Development of the peripheral and central venous catheter-related bloodstream infection prevention knowledge and attitudes scale: Nursing in Critical Care. *Nursing in Critical Care*, *26*(1), 35–41.
4. Bayoumi, M. M. M., Khonji, L. M. A., & Gabr, W. F. M. (2022). Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention: British Journal of Nursing. *British Journal of Nursing*, *31*(8), S24–S30.

5. Blanco-Mavillard, I., Castro-Sánchez, E., Parra-García, G., Rodríguez-Calero, M. Á., Bennasar-Veny, M., Fernández-Fernández, I., Lorente-Neches, H., & Pedro-Gómez, J. de. (2022). What fuels suboptimal care of peripheral intravenous catheter-related infections in hospitals? A qualitative study of decision-making among Spanish nurses. Antimicrobial Resistance and Infection Control, 11, 1–9. https://doi.org/10.1186/s13756-022-01144-5

6. de Sousa Salgueiro-Oliveira, A., Lima Basto, M., Muniz Braga, L., Arreguy-Sena, C., Nakahara Melo, M., & dos Santos Dinis Parreira, P. M. (2019). Nursing Practices in Peripheral Venous Catheter: Phlebitis and Patient Safety: Texto &

Contexto Enfermagem. *Texto & Contexto Enfermagem*, *28*, 1–13. https://doi.org/10.1590/1980-265X-TCE-2018-0109

7. Gabr, M. M. M. B. L. M. A. K. W. F. M. (2022). Changes in nurses' knowledge and clinical practice in managing local IV complications following an education intervention. *British Journal of Nursing*. https://doi.org/10.12968/bjon.2022.31.8.S24

8. Hernon, O., McSharry, E., Simpkin, A., MacLaren, I., & Carr, P. J. (2023). Effectiveness of structured self-evaluation of video recorded performance on peripheral intravenous catheter insertion: A randomised control trial study protocol. *Trials*, *24*(1), 182. https://doi.org/10.1186/s13063-023-07200-8

9. Hoskins, M. J., Nolan, B. C., Evans, K. L., & Phillips, B. (2023). Educating health professionals in ultrasound guided peripheral intravenous cannulation: A systematic review of teaching methods, competence assessment, and patient outcomes. *Medicine*, *102*(16), e33624. https://doi.org/10.1097/MD.0000000000033624

10. Høvik, L. H., Gjeilo, K. H., Lydersen, S., Rickard, C. M., Røtvold, B., Damås, J. K., Solligård, E., & Gustad, L. T. (2019). Monitoring quality of care for peripheral intravenous catheters; feasibility and reliability of the peripheral intravenous catheters mini questionnaire (PIVC-miniQ): BMC Health Services Research. *BMC Health Services Research*, *19*(1), N.PAG-N.PAG. https://doi.org/10.1186/s12913-019-4497-z

11. Huang, J., Liu, X., Xu, J., Ren, L., Liu, L., Jiang, T., Huang, M., & Wu, Z. (2024). Examining the effect of training with a teaching for understanding framework on intravenous therapy administration's knowledge, performance, and satisfaction of nursing students: A non-randomized controlled study. *BMC Nursing*, *23*(1), 104. https://doi.org/10.1186/s12912-024-01783-6

12. Keogh, S., Shelverton, C., Flynn, J., Mihala, G., Mathew, S., Davies, K. M., Marsh, N., & Rickard, C. M. (2020). Implementation and evaluation of short peripheral intravenous catheter flushing guidelines: A stepped wedge cluster

randomised trial. *BMC Medicine*, *18*(1), 252. https://doi.org/10.1186/s12916-020-01728-1

13. Korkut, S., Guler, S., Zincir, H., Yilmaz, D., & Avcil, K. (2022). Experiences and Observations of Nurses Regarding Dislodgement of Peripheral Venous Catheters: International Journal of Caring Sciences. *International Journal of Caring Sciences*, *15*(2), 1353–1362.

14. Marsh, N., Larsen, E. N., O'Brien, C., Ware, R. S., Kleidon, T. M., Groom, P., Hewer, B., Alexandrou, E., Flynn, J., Woollett, K., & Rickard, C. M. (2023). Safety and efficacy of midline catheters versus peripheral intravenous catheters: A pilot randomized controlled trial. *International Journal of Nursing Practice*, *29*(2), e13110. https://doi.org/10.1111/ijn.13110

15. Marsh, N., Webster, J., Mihala, G., & Rickard, C. M. (2015). Devices and dressings to secure peripheral venous catheters to prevent complications. *The Cochrane Database of Systematic Reviews*, *2015*(6), CD011070. https://doi.org/10.1002/14651858.CD011070.pub2

16. Massey, D., Craswell, A., Ray-Barruel, G., Ullman, A., Marsh, N., Wallis, M., & Cooke, M. (2020). Undergraduate nursing students' perceptions of the current content and pedagogical approaches used in PIVC education. A qualitative, descriptive study. *Nurse Education Today*, *94*, 104577. https://doi.org/10.1016/j.nedt.2020.104577

17. Munoz-Mozas, G. (2023). Preventing intravenous catheter-related bloodstream infections (CRBSIs): British Journal of Nursing. British Journal of Nursing, 32(Sup7), S4–S10. https://doi.org/10.12968/bjon.2023.32.Sup7.S4

18. Nickel, B. (2019). Peripheral Intravenous Access: Applying Infusion Therapy Standards of Practice to Improve Patient Safety: Critical Care Nurse. Critical Care Nurse, 39(1), 61–71. https://doi.org/10.4037/ccn2019790

19. Nickel, B. (2020). Hiding in Plain Sight: Peripheral Intravenous Catheter Infections: Critical Care Nurse. Critical Care Nurse, 40(5), 57–66. https://doi.org/10.4037/ccn2020439

20. Nunes De Almeida, A. C., Herculina Pires, M., De Souza Santana, I., De Oliveira Salgado, P., Vieira Toledo, L., Parreira, P., & Muniz Braga, L. (2022). EFFECTIVENESS OF AN EDUCATIONAL INTERVENTION FOR THE PREVENTION OF PERIPHERAL VENOUS CATHETER COMPLICATIONS. *Cogitare Enfermagem*, *27*, 1–13. https://doi.org/10.5380/ce.v27i0.87276

21. Oren, B., & Cuvadar, A. (2020). The Effectiveness of Training for Peripheral Venous Catheter Application in Intensive Care Units of a University Hospital: International Journal of Caring Sciences. *International Journal of Caring Sciences*, *13*(1), 163–170.

22. Purssell, E. (2017). Preventing infection in intravenous catheters in the community: British Journal of Community Nursing. British Journal of Community Nursing, 22(8), 374–377. https://doi.org/10.12968/bjcn.2017.22.8.374

23. Ray-Barruel, G. (2017). Infection Prevention: Peripheral Intravenous Catheter Assessment and Care: Australian Nursing & Midwifery Journal. Australian Nursing & Midwifery Journal, 24(8), 34–34.

24. Ray-Barruel, G., Cooke, M., Mitchell, M., Chopra, V., & Rickard, C. M. (2018). Implementing the I-DECIDED clinical decision-making tool for peripheral intravenous catheter assessment and safe removal: Protocol for an interrupted time-series study. *BMJ Open*, *8*(6), e021290. https://doi.org/10.1136/bmjopen-2017-021290

25. Ray-Barruel, G., Xu, H., Marsh, N., Cooke, M., & Rickard, C. M. (2019). Effectiveness of insertion and maintenance bundles in preventing peripheral intravenous catheter-related complications and bloodstream infection in hospital

patients: A systematic review. Infection, Disease & Health, 24(3), 152–168. https://doi.org/10.1016/j.idh.2019.03.001

26. Reid-McDermott, B., Browne, M., Byrne, D., O'Connor, P., O'Dowd, E., Walsh, C., Madden, C., & Lydon, S. (2019). Using simulation to explore the impact of device design on the learning and performance of peripheral intravenous cannulation. *Advances in Simulation*, *4*(1), 27. https://doi.org/10.1186/s41077-019-0118-5

27. Rochlen, L. R., Putnam, E., Levine, R., & Tait, A. R. (2022). Mixed reality simulation for peripheral intravenous catheter placement training. *BMC Medical Education*, *22*(1), 876. https://doi.org/10.1186/s12909-022-03946-y

28. Simões, A. M. N., Vendramim, P., & Pedreira, M. L. G. (2022). Risk factors for peripheral intravenous catheter-related phlebitis in adult patients. *Revista Da Escola De Enfermagem Da U S P*, *56*, e20210398. https://doi.org/10.1590/1980-220X-REEUSP-2021-0398en

29. Webster, J., Osborne, S., Rickard, C. M., & Marsh, N. (2019). Clinically-indicated replacement versus routine replacement of peripheral venous catheters. *The Cochrane Database of Systematic Reviews*, *1*(1), CD007798. https://doi.org/10.1002/14651858.CD007798.pub5

30. Zhang, L., Cao, S., Marsh, N., Ray-Barruel, G., Flynn, J., Larsen, E., & Rickard, C. M. (2016). Infection risks associated with peripheral vascular catheters. Journal of Infection Prevention, 17(5), 207–213. https://doi.org/10.1177/1757177416655472

APPENDIX 3 'JBI Critical Appraisal Checklist for Qualitative Research.

JBI CRITICAL APPRAISAL CHECKLIST FOR QUALITATIVE RESEARCH

Reviewer_____Date_____

Author_____Year_____ Record Number_____

		Yes	No	Unclear	Not applicable
1.	Is there congruity between the stated philosophical perspective and the research methodology?	☐	☐	☐	☐
2.	Is there congruity between the research methodology and the research question or objectives?	☐	☐	☐	☐
3.	Is there congruity between the research methodology and the methods used to collect data?	☐	☐	☐	☐
4.	Is there congruity between the research methodology and the representation and analysis of data?	☐	☐	☐	☐
5.	Is there congruity between the research methodology and the interpretation of results?	☐	☐	☐	☐
6.	Is there a statement locating the researcher culturally or theoretically?	☐	☐	☐	☐
7.	Is the influence of the researcher on the research, and vice- versa, addressed?	☐	☐	☐	☐
8.	Are participants, and their voices, adequately represented?	☐	☐	☐	☐
9.	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	☐	☐	☐	☐
10.	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

_____