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Aseptic measures during peripheral intravenous (PIV) therapy in health care settings

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Thesis abstract

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The aim of this thesis work was to identify the best aseptic procedures for the peripheral intravenous therapy in health care settings. The overall goal was to successfully describe aseptic measures to be taken for preparation, administration and management of intravenous therapy. This thesis was conducted by the Seinajoki University of Applied Sciences (SeAMK) in collaboration with Maseno University, Kenya.

The method of collecting data and analysis were achieved using review of literature and inductive analysis of searched materials. For this, we took the articles from the reliable databases (CINHAL, SeAMK FINNA) as well as renounceable health care guidelines from a 'Google' search engine. The information was extracted using different key words like intravenous therapy, Asepsis AND IV therapy, Infection control AND IV therapy, Peripheral IV therapy AND Asepsis and Peripheral IV therapy AND Infection control. For review and analysis 8 articles were chosen. Data analysis method of our research was based on the inductive content analysis method. The material under the main category was listed in three generic categories 'Preparation', 'Administration', and 'Management'. Which is further sub -categorized into different topics of findings. The ten different themes for findings identified were hand hygiene, environment, skin preparation, personal protective equipment (PPE), non-touch technique, insertion of PIV catheter, catheter site dressing, documentation, education and replacement of peripheral catheter.

Our findings suggested that, all health care professionals who participate in IV therapy must provide care based on the best evidence and best practices available. Also, the knowledge and abilities in safe and effective practice must be maintained throughout the work life of each individual practitioner and so every practitioner must adhere to robust IV practice standards and adhere to manual hygiene, aseptic techniques and it's uses.

Keywords: Intravenous, Peripheral intravenous therapy, infection control, asepsis

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Terms and Abbreviations

CDC	Centre for Disease Control and Prevention
CLABSI	Central Line-Associated Bloodstream Infection
IV	Intravenous
IVAD	Intravenous Access Device
PIV	Peripheral Intravenous
PIVC	Peripheral Intravenous Catheter
PPE	Personal Protective Equipment
PVC	Peripheral Venous Catheter
THL	Terveyden ja Hyvinvoinnin Laitos
VIP-Score	Visual Infusion Phlebitis-Score
WHO	World Health Organization

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1 INTRODUCTION

The threat to health systems worldwide are infections that are acquired from hospitals, that includes emerging multi-drug resistance organisms. The entire health care network must mobilize effective hospital acquired infections containment measures (Nekkab et al. 2017). Intravenous therapy is an application of medicines or fluids through the veins into the body. For these purposes it is possible to use both central veins and peripheral veins. It supplies the drug into the blood stream, so it works right away. Intravenous infusion therapy shall be used if a person has to quickly or for a long time receive fluids or drugs and also to the patients who are living in life threating situations or unable to take oral fluid. Additionally, IV infusion is needed when the drugs or fluids are not absorbed by the gastrointestinal tract. Up to 80% of the hospitalized patients undergo intravenous therapy during their admission in modern medical practice (Malik and Huda 2018). Peripheral IV catheters are mostly placed in the hand's veins at the upper extremity which join and finish in the peripheral veins and is measure about 3-6 cm. Through ultrasound, peripheral intravenous catheters may be positioned conveniently in arm’s veins which are difficult to palpate or imagine. Long peripheral IV catheters (8 cm or more) that are equipped especially of accessing lower veins, placement under ultrasonography guidelines are also available (Moureau 2019).

Healthcare workers are important members of a medical team that can help with their aseptic practice in preventing complications. Safe or aseptic health care practitioners can reduce prolonged patient hospitalization as well as systemic and local complications. Local complications could involve thrombophlebitis, inflammation, hematoma and sepsis, whereas circulatory overload, air embolization, septic shock can occur as systemic complications (Malik and Huda 2018). This final thesis will contribute to the improvement of aseptic procedures during peripheral intravenous therapy. This thesis will be conducted by the Seinajoki University of Applied Sciences (SeAMK) in collaboration with Maseno University, Kenya. The thesis aimed at enhancing the safety of patients in hospital conditions for infectious diseases.

2 THEORETICAL BACKGROUND

2.1 Asepsis and its importance in hospital settings

Asepsis is the state of being free from disease-causing contaminants or, preventing contact with microorganisms. The term asepsis often refers to those practices used to promote or induce asepsis in an operative field in surgery or medicine to prevent infection. Ideally, a surgical field is "sterile," meaning it is free of all biological contaminants, not just those that can cause disease, putrefaction, or fermentation, but that is a situation that is difficult to attain, especially given the patient is often a source of infectious agents. Therefore, there is no current method to safely eliminate all of the patients' contaminants without causing significant tissue damage. However, elimination of infection is the goal of asepsis, not sterility (Cooper and Gosnell 2018; Educalingo dictionary).

Simply to describe, an asepsis is free from contamination caused by harmful bacteria, viruses, or other microorganisms; surgically sterile or sterilized and it is very important to maintain aseptic procedures basically in the hospital premises because infections are the major cause of morbidity and vital cause of mortality basically during hospital care (Dhakal, Angadi and Lopchan 2016). Standardizing aseptic technique is essential to providing safe and reliable healthcare services. Historically, it is the domain of practice and guidance so, in the result, aseptic practice is often highly variable and not systematic such as poor in quality and confused in theoretically among the healthcare organizations. But in these practical realities, the patients are always expecting to protect themselves from the hospital environment and healthcare workers so that they are safe from the infection during the clinical procedures. So, it is important to be acknowledged that systematic aseptic technique is the ultimate defense between patients and clinical staff or mainly between infection and no infection (Rowley and Clare 2011).

2.2 Peripheral intravenous (PIV) therapy

Intravenous therapy is commonly used in hospital for administration of drugs or solutions directly into the blood stream. The therapy includes the preparation of treatment which includes the preparation of various drugs, management techniques, access of drugs. It also cares the frequency catheter exchange, dressings, devices and infusion solutions. Peripheral intravenous therapy is the crucial part for the treatment of various diseases. The therapy needs to follow the standard techniques in order to free from any contamination or risk hazards (Danski et al. 2016).

Intravenous drug preparation is a very significant and most frequently performed nursing operation. The IV push medication is given whenever the patient cannot take via the oral route or whenever the medication needs to be administered rapidly. The IV push medications are mostly given to treat moderate or severe pain. The steps include the preparation of drugs made from glass ampoule or, alternatively, the preparation of appropriate diluents and the mixing of drugs according to the standard protocol, the discarding of any excess content and the aseptic addition to the bag or direct injection to the patient (Curran 2011).

2.3 Asepsis in PIV therapy

Asepsis in intravenous therapy is an integral part in healthcare professions. Unsystematic ways of handling IV therapy cause many risks in contamination because it works directly the blood stream. Intravenous therapy is an application of medicines or fluids through the veins into the body. For these purposes it is possible to use both central veins and peripheral veins. It supplies the drug into the blood stream, so it works right away. Intravenous infusion therapy shall be used if a person has to quickly or for a long time receive fluids or drugs and also to the patients who are living in life threating situations or unable to take oral fluid. Additionally, IV infusion is needed when the drugs or fluids are not absorbed by the gastrointestinal tract. Up to 80% of the hospitalized patients undergo intravenous therapy during their admission in modern medical practice (Malik and Huda 2018).

2.4 Complications associated with PIV therapy

The right positioning of the IV catheter is very essential since the wrong placement of the push medicine may cause irritation and harm to the lining of the blood vessel and adjacent tissues. The effect of IV push medication is very rapid. Hence, it is extremely important to closely monitor the patient after the drug has been administered. The drug can be slowly administered and at the same time monitoring the patient (JoVE Science Education Database 2019).

The main complications for peripheral venous catheters (PVC) are local and systemic complications. Local complications include phlebitis manifested through tenderness and redness at the tip of the cannula and along the vein. Extravasation results due to swelling at and above I.V. site which results in discomfort and tight feeling, blanching, reduced skin temperature at the site and continuous fluid infusion even when the vein is occluded. Cannula dislodgement which can be caused by confused patient loosening or withdrawal from the cannula and Occlusion is manifested by difficult infusion flow which is common complication of PVC. The systemic complications include systemic infection, allergic reaction, circulatory overload and air embolism. The risk factors of PVC complications mostly comprise patient characteristics, therapy administered, practice of health professionals and materials used (Othman and Awad 2017).

Peripherally inserted central catheter can be associated with complications including central line-associated bloodstream infection (CLABSI), phlebitis, infiltration, occlusion, catheter leakage can lead to pleural effusion and peritonitis, cardiac arrhythmia, pericardial effusion, and cardiac tamponade. Peripherally inserted central catheter- related cases of CLABSI and pericardial effusion had been directly linked to neonatal death. Extravasation can lead to tissue necrosis, infection, limb disfigurement, and functional loss (Chenoweth, Guo and Chan 2018).

2.5 Infectious agents associated with PIV therapy

Infection with Staphylococcus aureus bacteremia is the major complication among PIV therapy (López et al. 2014, Hawkins et al. 2018). Such types of bacteremia accounts for up to 25 percent among all types of health-related infections (Hawkins et al. 2018) and is responsible for considerable morbidity and death, prolonged hospitalization and higher cost of hospital stay (López et al. 2014). Other most common PIV therapy related bacteremia is caused by Enterococci, Candida species and coagulase-negative Staphylococci (O'grady et al. 2011; Othman and Awad 2017).

The increase in antibiotic resistant pathogens has been a great threat in PIV therapy and even cause a lethal consequence during hospital stay. Among them; methicillin-resistant Staphylococcus aureus (O'grady et al. 2011; Helm et al. 2015), imipenem and ceftazidine resistance among Pseudomonas aeruginosa, fluconazole resistant Candida spp, cephalosporin resistant Klebsiella pneumoniae and E. coli (O'grady et al. 2011), vancomycin resistant Enterococcus (VRE), and carbapenem-resistant Enterobacteriaceae (Helm et al. 2015) are common. Most past trials revealed that, PIV therapy complications risk factors includes patient features, administered procedures, healthcare practitioners' practice, and used equipment. Specifically, nurses have significant duties in the implementation of intravenous therapy. Poor handling and administration of PIV therapy leads to severe occurrences of PIV therapy related complications (Othman and Awad 2017).

2.6 Mode of transmission of infections in PIV therapy

Generally, microorganisms are not capable to transmit freely within the hosts rather they need either direct physical contact with the new host or they need to use another person, animals or any object to get access. So, with the understanding of these kinds of direct and indirect ways of transmission, we can control the infection effective ways (Higginson 2011).

There are four recognized routes for contamination of catheters: 1) migration of skin organisms at the insertion site into the cutaneous catheter tract and along the surface of the catheter with colonization of the catheter tip; this is the most common route of infection for short-term catheters 2) direct contamination of the catheter or catheter hub by contact with hands or contaminated fluids or devices 3) less commonly, catheters might become hematogenously seeded from another focus of infection; and 4) rarely, infusate contamination might lead to infection (O'grady et al. 2011).

Health professional-to-patient cross transmission can arise when there are basic hand hygiene failures. This was clearly demonstrated when an organism found in patients' blood was also found in a nurse's artificial fingernail, and the nail was used to flip off drug vial lids. Patient-to-patient via health professional cross-transmission occurs when a health professional, knowingly or unknowingly, reuses contaminated equipment or drug vials. Such breaches in basic infection control have resulted in cross transmission of blood-borne viruses, bacteria and parasites. Environment-to-patient cross transmission arises when small aerosols containing microorganisms are liberated, for example, during procedures involving a water tap. The aerosols land on the equipment preparation area and are subsequently transferred into the infusate. The microorganisms arising from this route are usually opportunistic environmental pathogens, e.g., Burkholderia capecia (Curran 2011).

2.7 Aseptic Guidelines in Intravenous Therapy

Aseptic guidelines basically in intravenous therapy is an effort to maintain or keep the patients free from the possible hospital micro-organisms. There are certain inevitable aseptic guidelines for IV therapy which should be taken into consideration by all health professionals in hospital settings which are as follows (Carolinas HealthCare System, 2015):

Guidelines for the insertion of PIV catheter are

- Hand hygiene should be maintained with an alcoholic based hand rub before inserting an IV device.

- Wear Personal Protective Equipment (PPE) like gloves and mask with face shield.
- Select an optimal Insertion site, for example an adult can have the preferred PIV place is the dorsum of hand.
- Prepare skin at insertion site by using an alcohol/chlorhexidine solution by performing 30 seconds back and forth scrub and drying with air

Guidelines for the caring of PIV catheter are

- Hand hygiene should be maintained by using alcohol-based hand rub before contact with the IV dressing, site, devices and other attachments.
- Disinfect ports, hub, needleless connectors and stopcocks before you connect or inject. Use alcohol/chlorhexidine solution alcohol (scrub time is 15 second), dry it and clean properly visible blood stains from all ports, tubing, stopcocks and connections.
- Assess the PIV lines on a daily basis
- Replace the PIV if the site is no longer working or the sings of infiltration, phlebitis, purulence or other sings of infections.
- Always apply transparent dressings by using aseptic guidelines
- Always maintain the best sterile system: use sterile end cops, do not ‘loop’’ IV tubing back into the hub when disconnected for intermittent infusions, avoid breaks in the closed tubing system, and back prime compatible infusates for intermittent infusions

3 GOAL AND PURPOSE OF THE THESIS

With the standardization of IV practice, it will also assist the health care community as well as health organizations in reducing the risk of infection and in using evidence-based practice in nursing. Besides, it will also help to achieve better quality of life of patients and health care workers. Also, this final thesis will be intending to answer the following questions from our research:

a) What aseptic measures to be taken for preparation of intravenous therapy in the hospital?

b) What aseptic measures to be taken for administration of intravenous therapy in the hospital?

c) What aseptic measures to be taken for management of intravenous therapy in the hospital?

4 DATA COLLECTION METHOD AND ANALYSIS

The method of collecting data and analysis were achieved using review of literature and inductive analysis of searched materials. For the thesis method, data collection was undertaken to obtain accurate and up-to-date information from scientific articles. Data collection was aimed at collecting data from multiple publications and incorporating those data in the thesis method. Evidence for different parts of the study is obtained from different sources, which was further included in the thesis.

4.1 Review of Literature

An in-depth and evidence-based analysis for a subject is a form of formal literature review. There are several reasons for doing this, which influence the review's length and style. The literature review is essentially a key evaluation of the existing shared knowledge of a subject. Instead of being a comprehensive list of everything published, an informative, personal yet unbiased summary of the information should be a literary review. This kind of review offers a balanced perspective that includes conflict findings, contradictions, conventional and up-to-date thinking (Winchester and Salji 2016). In most scientific fields, literature reviews are extremely de-manded. Their necessity comes from the constantly growing output of scientific journals. The evaluation of literature involves the ability to interact with multiple tasks, from the identification and assessment of appropriate materials to information synthesis from different sources, from critical thinking to paraphrasing, evaluation and citing skills (Pautasso 2013).

4.2 Data collection

The information was searched using primary databases like EBSCO (CINAHL) and SeAMK FINNA. Also, the general search was done using ‘Google search’ engine. Initial searches about the research topic were done in 20th of September 2019, using these different databases. The information was extracted using different key words

like intravenous therapy, Asepsis AND IV therapy, Infection control AND IV therapy, Peripheral IV therapy AND Asepsis and Peripheral IV therapy AND Infection control. As presented in the figure 1, the data collection process was undergone step by step. At all phases, the results were recorded and assessed. For the related research 8 articles that met our inclusion / exclusion requirements, full-text publications were collected, and all three researchers checked each paper separately as it were listed separately in the Appendix 1.

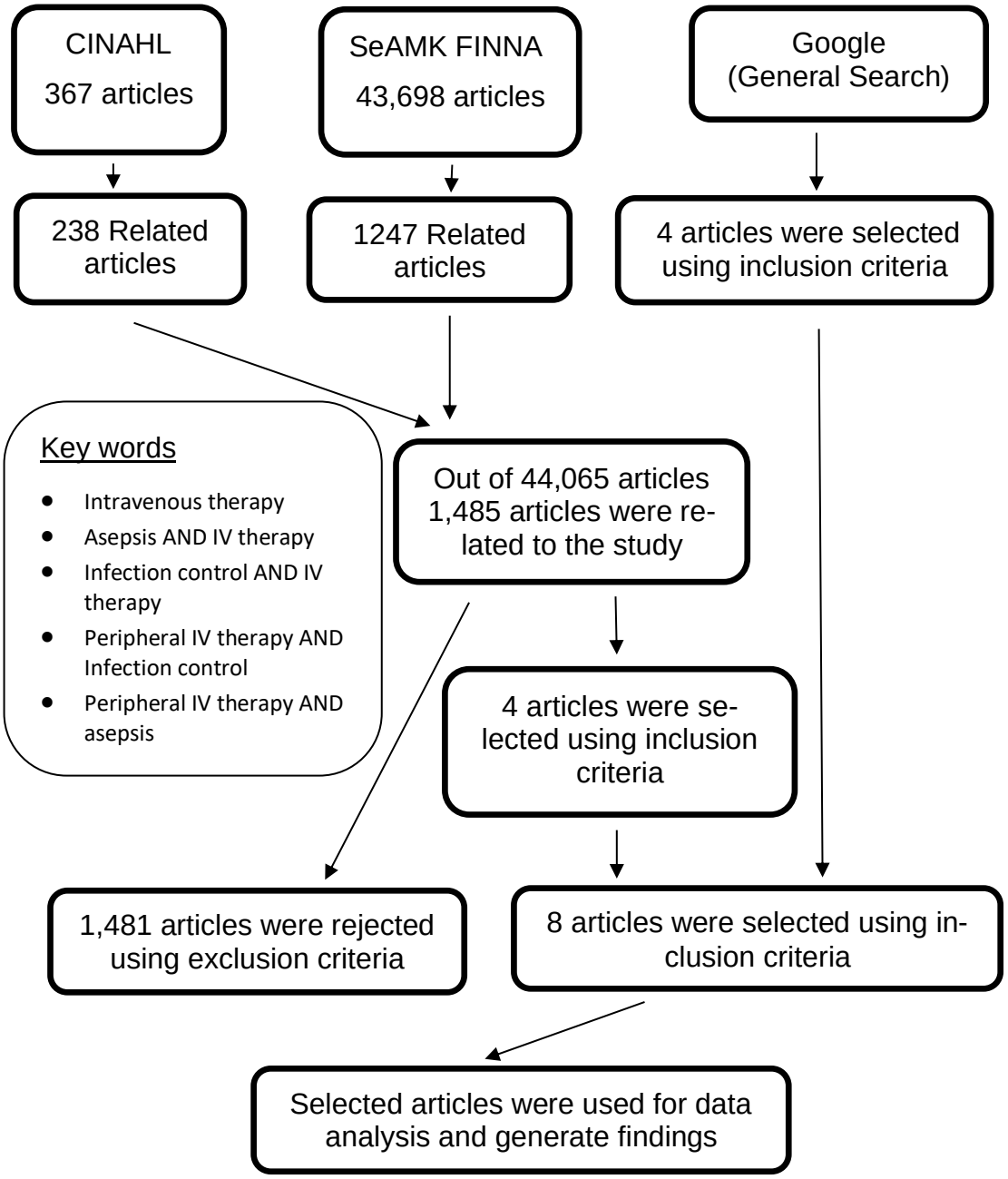

Figure 1. Flow chart of methodology

4.3 Inclusion and Exclusion criteria

The article search process was extensive as many of the articles need payment, membership or login information to be accessed. The articles were searched using key words and selected those that match the topic and eliminated those that were out of topic. The articles gave relevant background information and basis to build up research questions. The articles were selected only if they were available in full text, an empirical research, were peer-reviewed and published in English. The articles published only within 10 years at the latest were selected.

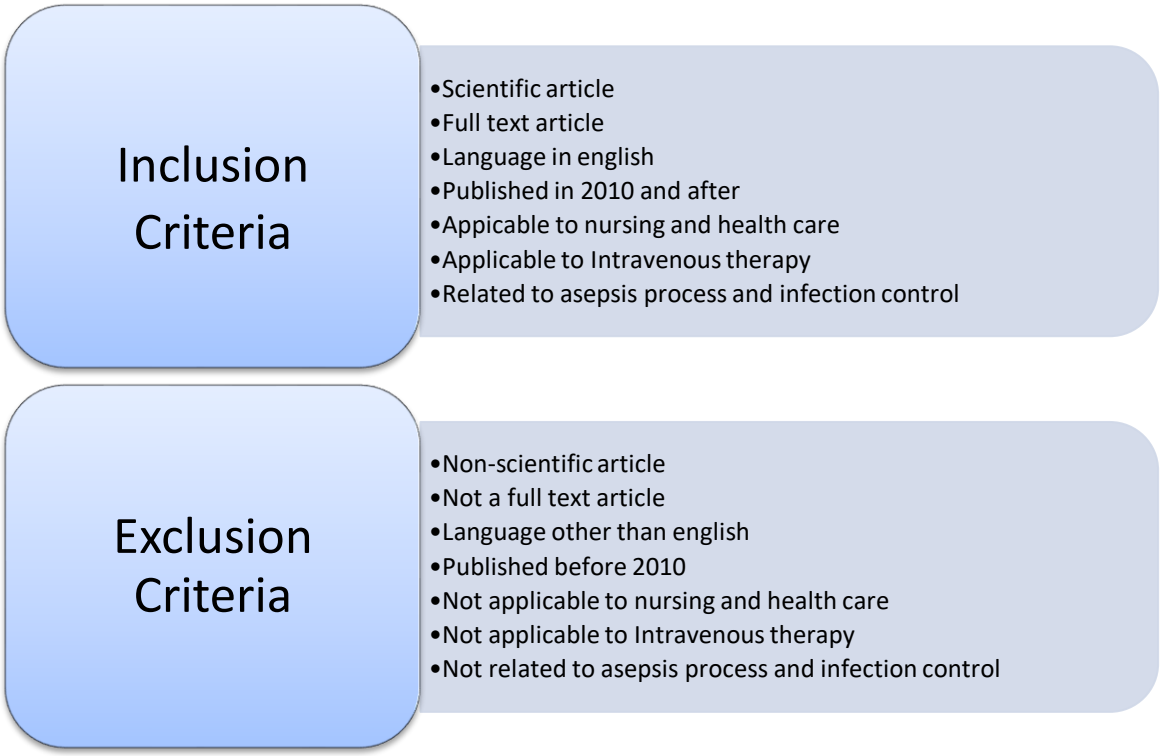

Figure 2. Inclusion and Exclusion Criteria

4.4 Data analysis

Data analysis method of our research was based on the inductive content analysis method. Inductive content analysis is the qualitative data analysis method in which previous knowledge of the research topic is limited and the data often explicitly draw codes, categories or themes (Cho and Lee 2014). The three primary steps of the inductive content analysis processes are: preparation, organization, and reporting

of results. The preparation stage consists of the processing, sensing and sorting of appropriate information for content analysis. The process of organization involves transparent coding, concept development and abstraction. During the reporting period, the findings are represented using inductive methodology in the form of the categories defining a phenomenon. (Elo et al. 2014).

While reading through material words and terms, such as aseptic, hygiene, intravenous care, documentation, reporting, infection care, infection control, sanitation, IV site care, health education and so on were either written in the margins of the paper or underlined. After coding the material papers containing these, words or terms were gathered as a further sub-category. The similar sub-categories were given as a common heading which was chosen to belong generic categories. After this, all the generic categories were linked to the main category which was our topic of research.

The process shown in figure 3, where the categorization of all the material used for the literature review is presented. The main category was our research topic. The material under the main category was listed in three generic categories ‘Preparation’, ‘Administration’, and ‘Management’. Which is further sub -categorized into different themes of findings.

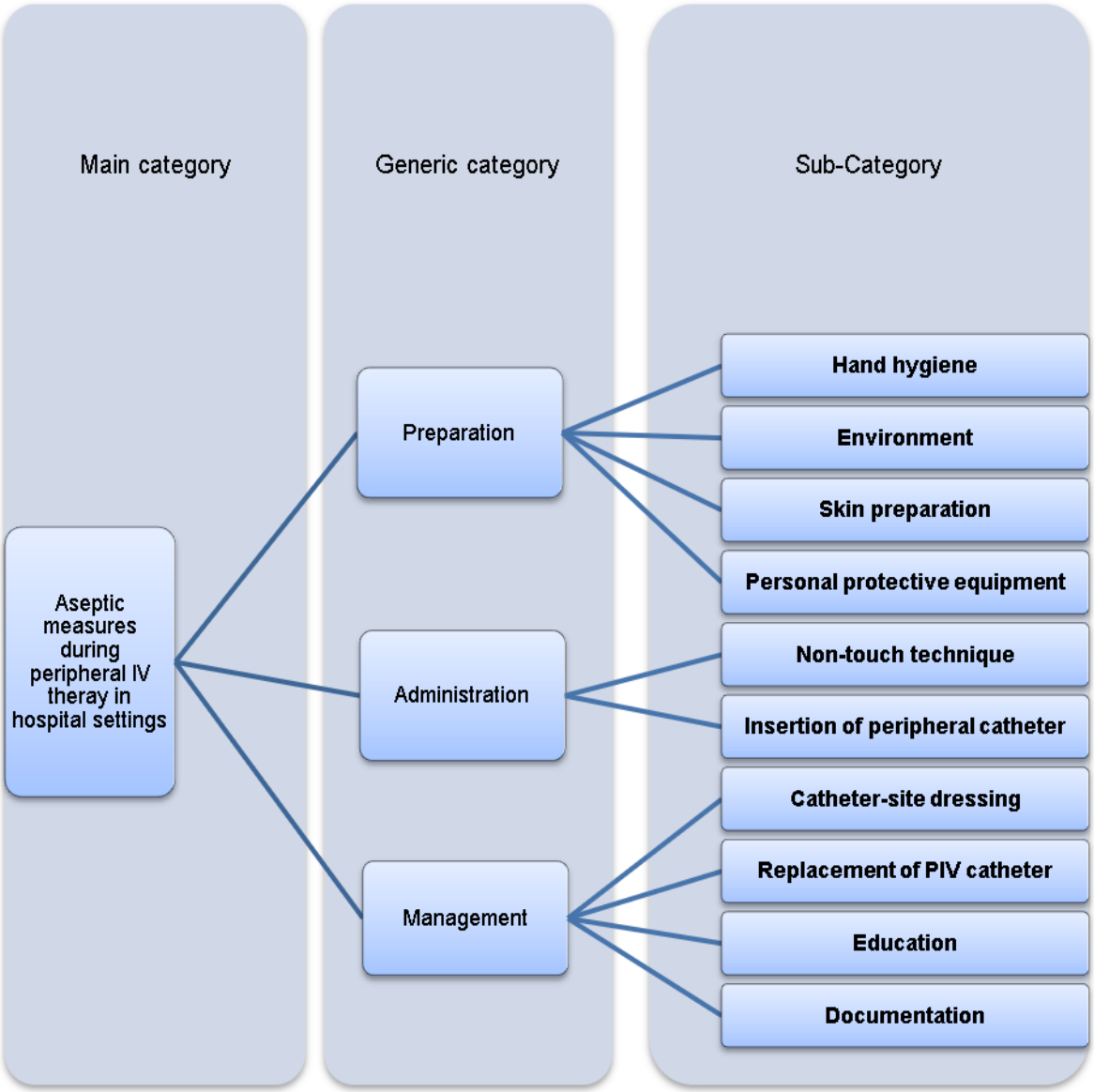

Figure 3. Data Analysis Process

5 FINDINGS

For the findings, ten different themes were identified and listed under three generic categories: preparation, administration and management. The ten different themes identified were hand hygiene, environment, skin preparation, personal protective equipment (PPE), non-touch technique, insertion of PIV catheter, catheter site dressing, documentation, education and replacement of peripheral catheter.

5.1 Preparation

In this generic category four different themes identified were hand hygiene, environment, skin preparation, personal protective equipment (PPE). These themes were separately described in the individual headings to tried to find out the answer of the research question.

5.1.1 Hand hygiene

Effective hand hygiene is essential to the prevention of infection. Transient bacteria can be removed by effective hand hygiene techniques. Antiseptic-containing soap solution or alcohol-based cleanser can be the best ways to maintain hand hygiene before and after procedures to all health professionals (NHS Southern Health 2018; O'Grady et al. 2011; Queensland Government 2018; Zhang et al. 2016). We should consider the certain procedures to maintain the hand hygiene. At first, we should wet our hand with water in water basin then should put enough soap in our hand so that it covers all our hand. Then should rub our hand palm to palm, right palm over to left dorsum with interlaced fingers and vice versa, palm to palm with fingers interlaced. In the same ways, back of fingers to opposing palms with fingers interlaced, then gently rubbing of left thumb clasped in right palm and vice versa. Again, rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa. Then, we should rinse hands with water and dry with single use towel. Finally, we should use towel to turn off the faucet and now our hands are

totally safe from any foreign microorganisms. This hand hygiene technique must be taken at least 30 seconds. In the same way, hand hygiene can be performed by using alcohol-based formulation with the above same procedures (Rowley et al. 2010).

5.1.2 Environment

Clinical rooms/procedure rooms should be designed to minimize cross infection risks. Surfaces within the procedure room should be free of clutter such as paper-work, books. Always close doors and windows during procedures wherever possible to minimize dust and eliminate insects. Do not use fans whilst undertaking any pro-cedure. The room and areas and surfaces that may have been contaminated during a procedure should be cleaned and disinfected between patients e.g. using a Clinell Universal Sanitizing wipe. This includes examination couches, dressing trolleys and examination lamps. Also, sterile equipment or dressings used for the procedure must be checked to confirm sterility before use i.e. the pack is not past use by date, packaging is intact and not spoiled by moisture. Sterile packs, single use tubes, sachets, ampoules, bottles of liquid must always be considered contaminated on the outside (so clean hands after touching and before putting on sterile gloves). Inside sterile packs remain sterile if peeled open properly. Sterile equipment should be stored with the recommendation of the manufacturer, in clean dry conditions at the correct temperature, off the floor and away from potential damage and should be protected from dust. (NHS Southern Health 2018).

5.1.3 Skin preparation

Good skin preparation reduces the risk of infection by reducing the potential risk of contamination from patients own skin flora. For example, 2% chlorhexidine glu-conate and 70% iso-propanol alcohol wipes should be applied to skin thoroughly for 30 seconds to a minute and allowed to air-dry (Zhang et al. 2016) in order to decon-taminate the skin before cannulation (NHS Southern Health 2018; Queensland Gov-ernment 2018). Skin preparation is the inevitable task while performing the

peripheral intravenous therapy. According to O'Grady et al. (2011), skin preparation should be done to follow certain procedures to avoid possible infections are below:

- Prepare clean skin with an antiseptic by using 70% alcohol, tincture of iodine, or alcoholic chlorhexidine gluconate solution before peripheral venous catheter insertion
- Prepare clean skin with a >0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, tincture of iodine, an iodophor, or 70% alcohol can be used as alternatives
- No comparison has been made between using chlorhexidine preparations with alcohol and povidone-iodine in alcohol to prepare clean skin (Unresolved issue)
- No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged below 2 months. (Unresolved issue)
- Antiseptics should be maintained to dry according to the manufacture's recommendation prior to placing the catheter.

Figure 4. Skin preparation procedure (O'Grady et al. 2011)

5.1.4 Personal protective equipment

It is very essential to wear PPE to prevent the transfer of potentially dreadful microorganisms from patient to staff or staff to patient (NHS Southern Health 2018) As a health professional, we should always use appropriate personal protective equipment according to the situation to manage the possible risk of infections. For example, we should use the gloves (sterile or not sterile accordingly), clinically approved marks, protective eyeglasses, gown, caps for head and so on should be used accordingly to protect ourselves for the possible risk management (NHS Southern Health 2018; NSW Government 2019)

5.2 Administration

In this generic category two different themes identified were non-touch technique and insertion of PIV catheter. These themes were separately described in the individual headings to tried to find out the answer of the research question.

5.2.1 Non-touch technique

Avoid touching sterile parts of equipment which will be in contact with other key parts and/or the patient's sterile or susceptible sites (NHS Southern Health 2018). Simply to say, non-touch technique is 'not touching of key-parts directly or indirectly' of instruments which are using PIVC and so on like cannula, syringe, niddles, etc. We should always open or peel the instruments to maintain sterility of the key parts. While setting up the needle and syringe, we should make sure the key parts are not touched by others but only another key parts. We should carefully maintain the sterility of key parts while mixing the medications as per require. In the same way, we should always clean a glass ampoule's neck with the 70% isopropyl alcohol and make it dry and then draw up the content with the needle carefully. And also, we should use the 70% isopropyl alcohol to a vial to clean its cover of rubber bung and allow to dry it for 30 seconds then puncture it to draw up the medication. Similarly, we should also clean the port of injection of the infusion bag with the 70% isopropyl alcohol then allow it to dry (Rowley et al. 2010).

5.2.2 Insertion of PIV catheter

Insertion of the peripheral catheter is an important task for all health professionals and this task have to be done recurrently in hospital setting for patient care (Queensland Government 2018). So, it is very important to take in consideration for certain recommended steps by clinicians to insert a PIVC using aseptic techniques.

It is very important to assess, consent and explain the procedure to the patients. With the hand hygiene we need to clean the trolley with alcoholic wipe and in the

same time need to collect all required equipment by checking sterile and expiry date. We need to ensure patient comfort and privacy including treatment area, adequate space, level of bed and staff member and the patient should be placed in suitable position and free from jewelers**.** Then we need to assess and select the patient's vein or catheter site by applying a clean tourniquet and to be cannulated, the protective sheet should be placed under the cannulated site but if unable to locate vein, release tourniquet, postpone procedure and seek assistance (O'Grady et al. 2011; Queensland Government 2018; NHS Southern Health 2018). And then again, routine hand hygiene should be performed accordingly for the preparation of aseptic field and equipment and should prepare aseptically IV flush and prime extension set. And again, perform routine hand hygiene for preparation of insertion (Clip hair from insertion site if necessary; Apply skin preparation solution and allow to air dry) then retighten the tourniquet. In the same way, we need to perform clinical hand hygiene (Use non-sterile or sterile gloves but sterile gloves are necessary if touching key parts and key sites). We should anchor vain below the puncture site and insert the cannula with aseptic technique then should attach extension tubing, flush IV cannula and dress and secure cannula. We should always dispose the waste into the appropriate waste bin. And again, hand hygiene should be performed by removing gloves and apron. And then, the patient should be returned to a comfortable position. And finally, it is very essential to provide the information to the patient to carry of cannula and the used devices should be documented the rightly then we should perform the routine hand hygiene for cleaning trolley with alcoholic wipes (NHS Southern Health 2018; Queensland Government 2018)

5.3 Management

In this generic category four different themes identified were catheter site dressing, documentation, education and replacement of peripheral catheter. These themes were separately described in the individual headings to tried to find out the answer of the research question.

5.3.1 Catheter-site dressing

Catheter-site dressing is very important for protecting of the possible risks of infection because it directly connects to the bloodstreams (Zhang et al. 2016). It must be performed with the following of systematic ways of ascetic procedures with certain instruments and items.

As a health professional, we should use a sterile, transparent semi-permeable dressing to protect the insertion site from contamination. Continuous observation the site should be routinized to stabilize and secure the device (NSW Government 2019; Queensland Government 2018; O'Grady et al. 2011). We should always use of chlorhexidine- impregnated dressings for the patients above 18 to protect the insertion site from contamination. But the use of chlorhexidine impregnated dressings in infants and children may require individual risk assessment and prescription should be considered. In the same way, we should use sterile gauze secured with a sterile transparent, semi-permeable dressing when the patient is diaphoretic or has excessive bleeding or oozing from the site, until this is resolved. We should consider that umbilical catheters do not routinely use an occlusive dressing over the insertion site but when the patient has multiple devices, each should be dressed separately unless the puncture sites are too close together. It is very essential that all used equipment for the dressing of the insertion site must be sterile and dressing must be placed so the insertion site is visible for regular inspection, therefore do not place non-sterile or opaque tape directly over the insertion site. All dressings must be changed if it becomes damp, loosened, no longer adherent, soiled and there is evidence of inflammation and/or there is an accumulation of fluid (NSW Government, 2019).

Table 1. Dressing change intervals (NSW Government, 2019)

Type of Dressing	Intervals of Replacement
Transparent, self-adhesive polyurethane, semi-permeable	Every 7 days or earlier if the dressing is no longer intact and the evidence of inflammation or moist
Chlorhexidine-impregnated	Every 7 days or at every dressing change
Gauze	Every 24 to 48 hours or if it is loose, soiled or moist

5.3.2 Replacement of PIV catheter

It is very essential to change or replace the administration sets of a peripheral catheter in certain situations and as a health professional we must maintain aseptic procedures to avoid the possible infections (Zhang et al. 2016; Gorski 2017). Basically, all the sets of administration must be replaced after being disconnected and if the catheter is changed or after blood has refluxed into the administration set and the blood is unable to be cleared by flushing. The catheter can be replaced every 72-96 hours or also before if there is any sing of infections or bacterial colonization (O'Grady et al. 2011; Queensland Government 2018; Zhang et al. 2016). In the same way, when the administration set is replaced, the IV fluid bag also must be changed. Infusion with blood, products of blood and high value medicines, careful consideration is highly required in the continuation of the product and assessment of possible risk must be noted to assess when the product is avoided and replaced with new lines or continue with the existing set. But if the contamination has happened all sets of line have to be changed. Similarly, disconnected administration sets must be discarded for routine care, such as in showering and changing gowns or nightwear and IV lines also must be replaced in the same time. On the other hand, disconnections should be controlled where reconnection of the set is immediate may be suitable in certain situations based on clinical requirements such as changing IV

access or infusion in operating theatre, administration of blood or blood products and so on. In this situation, aseptic technique must be highly maintained to prevent contamination of the set, for example if the disconnection becomes more than transient or the ends are contaminated, they must be discarded and replaced (NSW Government, 2019; Queensland Government 2018).

Patel et al. (2017) has different connotation on routine replacement of peripheral intravenous catheter. They did a case study of patient regarding PIVC and its routine replacement and concluded that it was not necessary to follow strictly routine unless there were certain causes of replacement. They compared the clinically indicated catheter replacement with routine replacement in the absence of a clinical indication like phlebitis, infections, infiltration, etc. gives no any benefit. And the author has certain recommendations for the PIVC care are below:

- Inspect closely each patient require for PIVCs and remove each PIVC as soon as possible
- Do not make routine replacement of well-functioning, well-appearing clinically necessary PIVCs the standard of care
- Examine regularly the sites of PIVC for the signs and symptoms of infection
- Remove a PIVC immediately if there is the indication of any clinical sign of complication (phlebitis, infiltration, blood stream infection, localized infection) and replaced the PIVC if only it is clinically necessary.
- When replacing the PIVCs on the basis of clinical, stablish the protocols for frequency of evaluation for further complications; and these protocols should mirror from prior studies.
- Replacement of any PIVC inserted during an urgent or emergent situation, the proper insertion technique cannot be guaranteed.
- Conducting the real-world observational studies ensure the switch to clinically driven replacement is safe and develop the standardized definitions of complication

Figure 5. Recommendation chart of PIVC care (Patel et al.2017)

5.3.3 Education

It is important to teach patients how to live safely from the infection with PIV therapy. The health professionals need to be educated about safe storage, maintenance and disposal of solutions, supplies and equipment (O'Grady et al. 2011; Gorski 2017; Queensland Government 2018) The health professionals need to know about signs and symptoms of adverse effects and prevention of complications such as air embolism, infection, catheter damage. The patients need to be educated about how to safely live and perform daily living such as how to dress / undress and bath along with PIV. The specific education programs among health professionals regarding PIV helps in reducing infection rates and improve good clinical practices (NHS Southern Health 2018; Gorski 2017).

Evidence-based training in cannulation, theory and simulated work, along with subsequent supervised training in the workplace, are great learning procedures that enable unreliable novices to become fully skilled. In addition, staff can educate patients to see for early signs of cannula site infection to help detect them early (Zhang et al. 2016).

5.3.4 Documentation

There is also clear evidence that feedback on results leads to better professional standards and improved health care. Records of every insertion of a catheter via an intravenous system care plan can reduce the incidence of infection with catheters. Initiating recording of the cannula injection allows others to start cannula treatment as early as possible for complications, including examination of the cannula site and removal of unnecessary cannula (NHS Southern Health 2018; Zhang et al. 2016).

Minimum documentation before inserting the PIVC such as patient education and consent need to be filled. This includes date and time of insertion, number of attempts, reason for insertion, local anesthetic (in case used), visualization and guidance technologies. It also includes site preparation, infection prevention, safety precautions taken, type, length and gauge/size of the device (PIVC), identification of

the insertion site by anatomical descriptors and landmarks, patency confirmation and ready for use. The patient health care record must include this record (NSW Government 2019).

After insertion, the condition of IVAD must be documented at least once by nursing staff or other health professionals during each shift. This includes checking any infections around the site of dressing or need to change dressing or any related to device or site. Once, the need of IV medications has been completed or urgency to remove for any particular reason, the IVAD must be removed following minimum documentation such as date and time of removal, reason for removal following condition of site, if any infections present and dressing need to be applied after removal (NSW Government 2019).

6 DISCUSSION

According to Florence Nightingale, “the angel of Crimea” or “the lady with the lamp”; “Wise and humane management of the patient is the best safeguard against infection”. Reflecting on this statement, the overall security of patient during the hospital stay relies on the hospital environment and health professional knowledge as well as management for overall infection control. The patients suffering from nosocomial infections is the result of bad aseptic practices. And, this always has been a question mark on the aseptic practices of treatment guidelines.

6.1 In General

PIV therapy is the most commonly used for intravenous drug treatment. This technique needs to be followed using standard aseptic guidelines. According to recent researches, there has always been higher possibility of blood stream infection risks of PIV catheters. The risk factors of infection in the categories of catheter related, health care related, dressing related always need special attention. And, this need to be followed through various infection prevention strategies including education, hand hygiene, skin disinfection, catheter dressing and securement, PVC replacement. Nurses are the most responsible personnel for PIV therapies. Hence, they can prevent the infection risks through simple follow of standard guidelines and also through good teamwork (Duncan et al. 2018).

The descriptive cross-sectional study carried out in Nepal by Osti et al. (2019) was mainly concerned about the care and maintenance of peripheral intravenous cannulation and to determine the knowledge and practice of nurses towards care and maintenance of IV cannula. The study was assessed collecting data through nineteen questions. These questions also share the same topics as we have discussed in our findings. The questions were formulated based on topics like insertion, insertion site, during and removal of IV catheterizations, aseptic non touch technique, hand hygiene, environment sanitation, catheter material, size, time period, patient education, dressing. The Nepalese nurses were found to be aware of CDC

guidelines for intravascular catheter related infections which we have also included in our study standard guidelines.

As it is said hand hygine is very essential task, must perform by the healthcare professionals to prevent from the possible infections and it has described well its procedures in previours chapter of finding. But it is very essential to know the appropreate moments, also called key moments for performing the hand hygiene by all health professionals and the recommended key moments for hand hygiene are before touching the patients, before clean or aseptic procedures, after body fluid exposure, after touching a patient and after touching patient surrounding (WHO 2020).

Despite Peripheral intravenous (IV) catheter insertion being the most common invasive hospital procedure performed worldwide, there has always been an unacceptably high overall failure rate of 35% to 50% in even the perfect hands (Helm et al. 2015). Catheter failure is always expensive for clients, treatment providers and health care system. Nurses and health care providers can realize the catheter failure through several visual symptoms, e.g. phlebitis, infiltration, occlusion or mechanical failure, dislodgment and infection, any of which alone or in combination. The failed catheter needs to be immediately removed, before the completion of its intended dwell time or before the 72-96 hrs dwell time limit, traditionally specified by the centres for disease control and prevention (CDC) (Helm et al. 2015). This always lies as a crucial responsibility of experienced nurses and health care professionals. A failed IV catheter indicates the need for the treatment of mild, serious IV catheter defects, discomfort, unsatisfaction, prolongation of the procedure, venous depletion. This often affects a patient’s overall hospital experience and is beyond patient treatment ethics. It is not to be readily taken into account the penetration of a patient's natural protective skin barrier with a foreign body that connects the outside world directly to the bloodstream for an extended time. The insertion of an IV catheter is an invasive method that entails multiple risk, possible morbidities and even death and hence need to be given the respect that it deserves.

Nurses have great role in intravenous drug therapy treatment. It is necessary for them to gain knowledge on insertion and maintenance of intravascular catheters for

infection prevention. They need to be up to date on their education and always follow standard guidelines during insertion, after insertion and removal of intravascular catheters. It is recommended to nominate only trained nurses or other health professionals who can exhibit their competence or skills for the insertion and maintenance of these intravascular catheters (O' Grady et al. 2011). Also, the evidence-based study performed by Nickel (2019) suggested that the non-touch technique is crucial part during PIV catheter insertion as mentioned in our findings. The cleansing of PIV insertion site with >0.5% unless contraindicated, allowing to fully dry and if in case the insertion site need to retouch for palpitation after cleansing, sterile gloves must be used. This evidence based key point share our findings whereas Nickel, B (2019) also considers 20g catheter as standard for most therapies and 22g in fragile, smaller veins in order to prevent infections.

As a health care professionals, it can notice in our daily activities of working life, the proper management of catheter site is the most challenging task though there is the systematic routinized taking care of it. It is because, it directly touch the bloodstreams and it has great risk of infection. We use it for supplying medication, bodily fluids and other bodily required elements directly to the venous so catheter site dressing is very important in routinized ways and even in every dressing also the catheter site must be checked whether it is in proper function or even it has some infection too. The catheter site is monitored in every shifts during intravenous treatments. According to evidence-based study performed by Nickel (2019), the choice of PIV insertion site includes avoiding areas of flexion and areas of pain on palpation, avoiding compromised areas and sites distal to these compromised areas and antecubital fossa. He also mentions to closely observe the site (at least every 1-2 hours) for any signs of infection if an area of flexion is the insertion site. In general practice, the visual infusion phlebitis (VIP) score method is used to evaluate the catheter site as mentioned in Table 2.

Table 2: Visual Infusion Phlebitis (VIP) score (VIP Score 2020)

IV Site appears healthy	0	No sign of phlebitis (Observe Cannula)
One of the following signs is evident: – Slight pain near IV Site – Slight redness near IV site	1	Possibly first signs of phlebitis (Observe Cannula)
Two of the following are evident: – Pain at IV site – Redness – Swelling	2	Early stage of phlebitis (Resite Cannula)
All of the following signs are evident: – Pain along path of cannula – Redness around site – Swelling	3	Medium stage of phlebitis (Resite Cannula / Consider Treatment)
All of the following signs are evident and extensive: – Pain along path of cannula – Redness around site – Swelling – Palpable venous cord	4	Advanced stage of phlebitis or the start of thrombophlebitis (Resite Cannula / Consider Treatment)
All of the following signs are evident and extensive: – Pain along path of cannula – Redness around site – Swelling – Palpable venous cord – Pyrexia	5	Advanced stage thrombophlebitis (Initate Treatment / Reside Cannula)

6.2 In Finland

The use of peripheral vein catheters is very common in hospital patients. According to a 2016 European prevalence study of treatment-associated infections, 51% of patients in Finnish acute hospitals had a peripheral venous catheter. During the insertion of the peripheral catheter, the puncture site is disinfected with ≥70% alcohol or 2% chlorhexidine alcohol. But, finnish health care system strongly believes and also widely in practice in finnish health care settings that the way of one-time alcoholic wipe in one diection for skin prepartion is the best way for avoiding the possible risk of infections. In the same ways, before the insertion of IV cannula, hands must be disinfected accordinly with soap and water or hand rub and then we must use the clean gloves. The injection site is no longer touched. Catheter site dressing is changed every 5-7 days. If fluid builds up under the protective membrane, the injection site is protected with a gauze dressing that is changed at least every other day or when it becomes wet. The catheter is not routinely replaced. However, a catheter placed in a primary care setting must be removed or replaced as soon as possible, and at the latest within 48 hours. Also, the catheter removal is recorded (THL 2020). The base of the catheter is checked in every shift. The amendment takes into account: signs of infection such as redness, swelling and secretion, and other complications, catheter function and placement and condition of protective film. Observations are recorded and a Visual Infusion Phlebitis (VIP score) can be used to evaluate (THL 2020; HUS 2018).

7 CONCLUSION AND FURTHER RECOMMENDATION

Although, it is challenging to control the infection but if standard aseptic procedures are followed in proper manner, we can take control on them. Therefore, special caution needs to be taken during handling of PIV devices to control the infection from it. From our research it was found that, all health care professionals who participate in PIV therapy must provide care based on the best evidence and best practices available. Also, the knowledge and abilities in safe and effective practice must be maintained throughout the work life of each individual practitioner and so every practitioner must adhere to robust PIV practice standards and adhere to manual hygiene, aseptic techniques and it's uses. This research tried to find out most of the possible solution regarding PIV therapy infection control during preparation, administration and management and its output results will possibly enlighten the healthcare professionals for the best aseptic practice. But, with the time being the technology and evidence-based practice will find out the more and different best practices for aseptic measures during PIV therapy. Therefore, it is suggested to do further research for the search and finding of best PIV therapy aseptic procedures during the patient care.

8 ETHICALITY AND RELIABILITY

We as a nurse need to know and follow ethical guidelines when the research is related to the human subject. In every professional relationship, the nurse practices with the compassion and respect for the inherent dignity, value and uniqueness of every individual (Manton et al. 2014). It is often impossible to consider the ethical issues of the initial papers and methods when performing literature reviews as several of the studies will not elaborate on the matter. The idea of making a descriptive ethical assessment of the original studies in this research would have been helpful but we could not provide a reader with such reports due to limitations on resources and time on this analysis. It would have been good to give a specific ethical evaluation. The consistency of the research could have been improved by a recognized ethical assessment in the literature review. Therefore, we committed to the standard process of review of literature. Our own interpretation and opinion will be use during the analysis of articles to be ethically objective. We also concerned, only data from scientific articles or publications by original authors will be use. Besides, we will also ensure that the data gathering process will be accordance to the scientific guidelines as well as SeAMK guidelines. We will also alert about the plagiarism and guess work in our findings.

The validity refers to the integrity and application of the processes and the accuracy of the findings, while reliability refers to the consistency of the analytical procedures used (Noble and Smith 2015). For this, we took the articles from the reliable databases (CINHAL, SeAMK FINNA) as well as renounceable health care guidelines from a ‘Google’ search engine. We together with supervisors also examine and interpret each article independently and subsequently to come into the final common conclusion. Also, the supervisor's draft and comments are used to sort out the differences. Problems are also sent to the e-mail of our supervisor to confirm their subsequent comments and decisions.

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APPENDICES

APPENDIX 1. Articles, Sources and Finding extraction

Appendix 1: Articles, Sources and Finding extraction

Number	Author	Year	Database	Publication	Title	Theme extracted for our Findings
1.	Gorski, L.A.	2017	CINHAL	Home healthcare now	The 2016 infusion therapy standards of practice.	Education, Replacement of PIV catheter
2.	NSW Government	2019	Google Search	Health Policy Statement	Intravascular Access Devices (IVAD)-Infection Prevention and Control	Replacement of PIV catheter, Documentation, Catheter-site dressing, Personal protective equipment
3.	NHS Southern Health	2018	Google Search	NHS Foundation Trust	Aseptic Technique and Clean Technique Procedure, Infection Prevention and Control Policy	Education, Documentation, Personal protective equipment, Insertion of PIV catheter, Non-touch technique, Skin preparation, Environment, Hand hygiene
4.	O'grady, N.P. et al.	2011	SeAMK FINNA	Clinical infectious diseases	Guidelines for the prevention of intravascular catheter-related infections.	Education, Replacement of PIV catheter, Catheter-site dressing, Insertion of PIV catheter, Skin preparation, Hand hygiene
5.	Patel, S.A., Alebich, M.M. & Feldman L.S.	2017	Google Search	Journal of Hospital Medicine	Routine Replacement of Peripheral Intravenous Catheter	Replacement of PIV catheter
6.	Queensland Government	2018	Google Search	Department of Health	Guideline. Peripheral Intravenous Catheter (PIVC)	Education, Replacement of PIV catheter, Catheter-site dressing, Insertion of PIV catheter, Skin preparation, Hand hygiene
7.	Rowley, S. et al.	2010	CINHAL	British Journal of Nursing	ANTT v2: an updated practice framework for aseptic technique	Non-touch technique, Hand hygiene
8.	Zhang, L. et al.	2016	SeAMK FINNA	Journal of infection prevention	Infection risks associated with peripheral vascular catheters	Education, Replacement of PIV catheter, Documentation, Catheter-site dressing, Skin preparation, Hand hygiene