



Prevention methods to prevent central line-associated bloodstream infections (CLABSIs)

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Central venous catheter (CVC) is used to monitor hemodynamic indexes, administer intravenous medication, transfusion, blood products and parenteral nutrition. However, as an invasive diagnostic and therapeutic method, it can be easily colonized by microorganisms, which may lead to catheter-associated bloodstream infection (BSI) and other complications, making treatment difficult and increasing patient pain and medical costs. Central venous catheters are widely used in the emergency department, Intensive Care Unit and other clinical departments. As medical technology advances, what preventive measures have been reported to reduce blood stream infections associated with central venous catheters what concepts and new concepts can be learned? We find these answers through literature review, which can guide clinical nursing practice. And to investigate the effects of various prevention methods on central venous catheter-associated bloodstream infections.

We searched Medic, Joanna Briggs (Ovid), ProQuest, PubMed, Cinahl with fulltext (EBSCO), Cochrane Reviews. The search keyword is CATHETER-RELATED BLOODSTREAM INFECTION. Studies addressing care and maintenance of central venous catheters, published from January 2015 to May 2020 were searched. Inclusion criteria were studies published in the last five years, written in English, in adult patients, involving care and maintenance before, during and after catheterization, and involving abstract or title of the subject. Exclusion criteria were papers addressing a pediatric or neonatal population; addressed peripherally inserted central catheter (PICC), hemodialysis, or peripheral and arterial catheters; or did not address preventive measures to prevent central line-associated bloodstream infections. Design tables to collect data and analyze data.

All of these articles have been written within the last 9 years. Most of the authors are from ICU, Anesthesiology, Surgery and other clinical departments and come from different countries, America, France, Japan, Greece, Jack, Australia, China, Finland and so on. Methods for preventing catheter-related bloodstream infections include aseptic procedures, barriers, management, and strategies.

Prevention of bloodstream infections associated with central venous catheters requires multidisciplinary collaboration. The goal of an effective prevention program should be to minimize CRBSI as much as possible. Catheter colonization is an important monitoring index to study catheter-related bloodstream infection and provides a theoretical basis and evidence-based method for our clinical nursing measures to prevent central venous bloodstream infection.

Keywords: central venous catheter, CLABSIs, nursing education, nursing technique

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1 Introduction

The paper on central venous catheter associated infection is of great significance to us as nursing students. Catheter-related bloodstream infection is not only an important problem in clinical care, but also an important research topic in scientific research. It is related to patient health, well-being, survival, and mortality, as well as the quality of clinical care, and the consumption of medical resources. It can be said that prevention of central venous catheter infection is the most important part of clinical nursing work.

CVC is a very important device in clinical work. Especially for critically ill patients and patients requiring long-term treatment, CVC can reduce the pain of repeated puncture and facilitate clinical emergency treatment, intensive care, chemotherapy, as well as drug administration, blood transfusion and parenteral nutrition during surgery. Central venous pressure can also be monitored. At present, it is widely used in clinical treatment. (Han Xu & Yujia Wu 2017)

Because of this increased use, the incidence of central line-associated bloodstream infections is increasing. The number of infected cases is increasing year by year. We firmly believe that prevention is better than cure. Early prevention is crucial to maintaining a patient's health, rather than the long and painful process of treatment after infection. Through the collection and statistics of data in this literature review, we hope to find out the causes of infection, more effective prevention methods, and find a better research direction in the prevention of central venous catheter-related bloodstream infection in the future. (Xiuwen Chi, Juan Guo, Xiaofeng Niu, Ru He, Lijuan Wu, Hong Xu 2020).

In many years of clinical work in China, we have also noticed that nurses attach varying degrees of importance to catheter-related infections. The degree to which CLABSIs is valued by clinical nurses and the techniques used to maintain it play a critical role in infection. According to statistics, as the most common complication of central venous catheters, the incidence of central-line related bloodstream infection is 4.1/1000 central line days (Xiuwen Chi et al 2020).

In fact, CLABSIs is thought to be largely preventable through things like hand hygiene, using full-barrier precautions during central venous catheter insertion, cleaning the skin with chlorhexidine, and removing unnecessary catheters. (Xiuwen Chi et al 2020)

Therefore, we believe that retrospectives and prospects are necessary for data collection and analysis of CLABSIs. Through this article, we hope to arouse the attention of nursing staff to CLABSIs. At the same time, it is also hoped that patients can attract attention and receive

more education, to unite the front in the prevention of CLABSIs and work together to reduce or even eliminate CLABSIs.

The purpose of this study was to investigate the effect of different methods for prevention of CLABSI on central venous catheter-related bloodstream infection. By evaluating the prevention methods of central venous catheter bloodstream infection, we can guide the best clinical practice. At the same time, we also hope to arouse the attention of clinical nurses and patients to CLABSI, deepen their understanding of central venous catheters, improve the nursing and prevention skills of CVC-related infections, and make people feel comfortable and safe when using central venous catheters. What preventive measures have been reported to reduce blood stream infections associated with central venous catheters ? What new concepts can be learned through literature review ? With these questions in mind, we began our literature review.

2 Methods

2.1 Theoretical background of literature

The literature review is a comprehensive analysis, summarization, and commentary on the current status, new developments related to a particular topic or theme. It aims to be systematic, comprehensive, and reproducible. Its goal is to identify, evaluate, and synthesize extant evidence that has been presented by other researchers with as little bias as possible, including the main academic viewpoints nowadays, previous research results, arguments, problems, and possible reasons, etc. The literature review requires the author to synthesize and present the main ideas of the information reviewed, and also to provide a more specialized, comprehensive, systematic discussion and corresponding evaluation of the synthesized literature according to his or her own understanding and knowledge (Efron, S, E & Ravid, R 2018). Literature review is important because even for a specific topic, because of the limited resources of a single person, also because of the limitations of the relevant knowledge acquired, not one person can collect and process all the previous and latest experimental results, research reports, developments, and information etc. Therefore it is effective to use a literature review to gain relevant knowledge on the particular topic in question, but it should also be understood when conducting a literature review that not all literature is of good quality and accurate data, and a reasonable screening and selection of the collected literature should be done. (Aveyard, 2010)

2.2 Research plan

We searched Medic, Joanna Briggs (Ovid), ProQuest, PubMed, Cinahl with fulltext (EBSCO), Cochrane Reviews. The search keyword is CATHETER-RELATED BLOODSTREAM INFECTION. Studies addressing care and maintenance of central venous catheters, published from January 2011 to May 2020 were searched. Inclusion criteria were studies published in the last five years, written in English, in adult patients, involving care and maintenance before, during and after catheterization, and involving abstract or title of the subject. Exclusion criteria were papers addressing a pediatric or neonatal population; addressed peripherally inserted central catheter (PICC), hemodialysis, or peripheral and arterial catheters; or did not address preventive measures to prevent central line-associated bloodstream infections. We collected not only nursing literature, but also relevant CRBSI literature from other departments. Nursing literature mainly focuses on implementation, while other basic research literature can provide theoretical basis for the implementation of preventive measures, which is also the research method required by the development of evidence-based nursing. Shown in the table 1 below :

Search terms	Databases	Inclusion criteria*	Exclusion criteria
prevention methods of central venous catheter-associated bloodstream infections	Medic, Joanna Briggs (Ovid), ProQuest, PubMed, Cinahl with fulltext (EBSCO), Cochrane Reviews	Studies published in the last nine years, written in English, in adult patients, involving care and maintenance before, during and after catheterization, and involving abstract or title of the subject.	Papers addressing a pediatric or neonatal population; addressed peripherally inserted central catheter (PICC), hemodialysis, or peripheral and arterial catheters; or did not address preventive measures to prevent central line-associated

Table 1 Research plan (*Our original plan was to include relevant literature in the past five years. When we searched for an upgrade guide from 2017, the original version was from 2011, and the quality of the guide was so high that it was included.)

2.3 Data collection plan

In order to collect information and data more effectively, we designed a data collection table. Include author information, study objectives, participants, data collection methods, data analysis methods, and main results. See table 2 below :

Author, year, country	Purpose of the study	Topic	Data collection method	Data analysis method	Main result/ Conclusion

Table 2 Literature review data chart.

We collect as much data as possible, and this table provides some methods for conducting systematic review studies in the future.

2.4 Data analysis methods

Analysis of the data in the data collection table is mainly to summarize and content analysis on the literature searched. We analyze the author's background, whether the literature is the latest research results, and the topic and purpose of the research. The data collection and data analysis methods of each literature were analyzed in order to objectively reflect the scientific nature of the research and whether the evidence was credible. The most important thing is to analyze and synthesize the main results and conclusions.

3 Theoretical background

In this topic, we will discuss the definition of a central venous catheter, including what a central venous catheter is and its use. Definitions of infection, including definitions of CLABSIs, hazards of infection and a brief discussion of prognosis. So that we can have a more intuitive understanding of CLABSIs and the importance of its prevention.

3.1 Background of CVC

Firstly, we need to have a preliminary understanding of the central venous catheter, what is the central venous catheter, what is its role and use, what kind of patients use this technique, etc. To further discuss CLABSIs, we can have a more intuitive understanding of the causes and pathways of infection.

3.1.1 Definition of CVC

The central venous catheter (CVC) is a catheter that pass through the subclavian, internal jugular, femoral vein tube with a tip in the superior vena cava or inferior vena cava (Ling, Apisarnthanarak, Jaggi, Harrington, Morikane, Thu, Ching, Villanueva, Zong, Jeong & Lee 2016). CVCs are an essential part of the management of critically ill patients, serving both as reliable vascular access and the site of venous pressure monitoring.

The central venous catheter (CVC) is a silicone and PVC material pipeline which can be divided into a variety of models, including single-cavity, double-cavity, three-cavity central venous catheter, etc. Clinically, different types and models of catheters are selected according to their different uses, indwelling time, and patients' own conditions. The main types are as follows: non-tunnel catheters are suitable for short-term use when peripheral venous access cannot be established. Tunnelling catheters are suitable for >30 days of treatment, such as chemotherapy, antibiotic therapy, parenteral nutrition, and infusion of blood products. Fully implanted or surgically implanted catheters (PROTS or Port-A-CATHS) are suitable for patients with long-term infusion requirements and a low risk of infection. The primary limitation of PICC through peripheral veins, such as the superior great vena cava (SVC) catheter through the noble vein, brachial vein, or less commonly used cephalic vein, is that the higher risk of thrombosis limits its duration of use. (Han Xu & Yujia Wu 2017 & Robert Thach 2019)

3.1.2 Application of CVC

In general, patients in emergency department, ICU ward, anesthesiology department, hemodialysis room and other departments are more commonly used, which can measure the central venous pressure to evaluate the amount of fluid replacement. For patients with malnutrition, it can be used as a way of long-term parenteral nutrition, and a large amount of rapid intravenous infusion can be given through a central venous catheter to maintain blood pressure after major surgery with large amount of blood loss. Uremia patients are often used as vascular access for hemodialysis, and tumor patients can be injected with tumor chemotherapy drugs through central venous catheter to prevent the occurrence of phlebitis. Central venous catheter is an important auxiliary treatment material in medical clinic. (Jiang Wenli 2015 & Moi Lin Ling et al 2016)

3.2 Definition of CLABSIs

We reviewed a number of related papers and reviews on the definition of centerline-associated bloodstream infection, and combined with the thesis of this review, we concluded that CLABSIs is a laboratory-confirmed bloodstream infection in which the patient received a central intravenous injection 48 hours prior to diagnosis. This infection was not associated

with other tissue site infections. The centerline is also defined as an endovascular access device or catheter that terminates at or near the heart or large blood vessels. (Paplawski 2020.)

Because the centerline is located in the large veins near the heart, such as the jugular vein, femoral vein. So once infection occurs, it can have a very serious impact on the human body. In addition to affecting the patient's body, infection will also increase the pain of patients and their families, reduce happiness, and prolong the hospital stay. As the length of hospital stay lengthens, the treatment and care for infection also increases the consumption and waste of medical resources. That's why we've been emphasizing prevention over cure. (Ullman, Debbie, Claire M. & Rickard.2014)

With the development of medical technology, the application of puncture catheter is more and more widely, followed by more and more catheter-related bloodstream infection problems. A meta-analysis shows that patients with CLABSI were 2.75 times more likely to die than those without CLABSI, and it costs an extra \$46,000 per case to control and treat the infection (Xiuwen Chi et al 2020). So, to prevent infection at its root is to save the patient's life. This is also the significance of this literature review.

3.3 Catheter colonization

This is a term associated with infections associated with central venous catheterization. Hideto, Masamitsu, Takayuk, Nobuaki, Tetsuya, Junji, Shohei, Shinji, Hiroshi, Kohkichi, Ryutaro, Kyo, Eiichir, Nobuyuki, Satoshi, Kentaro, Ryota, Yasuhiro, Atsuko Kobaya, Toru, Alan (2017) in a multicenter randomized controlled study, catheter colonization was defined as quantitative or semi-quantitative culture of the catheter head, subcutaneous portion, or catheter junction to confirm microbial growth (& GT; 15 Colony Forming Unit (CFU).

According to Hideto (2017, Yu, Huihan and Yan et al (2019) recent research, catheter colonization should be used as an important indicator for monitoring and treatment of central venous catheter-associated hematoascular infection. Because the catheterization provides an entrance for the colonization of pathogenic bacteria, it is easy to lead to hematogenous infection.

But the other research shows different point of view. CRBSI is considered to be the gold standard that defines CAI. However, due to the difficulty in early clinical capture of CRBSI, catheter colonization was also used as an alternative standard in many studies (Krikava, Kolar, Garajova & Balik et al 2020 ; Hideo et al 2017 ; Yu et al 2019). In a meta-analysis study, however, other ideas were suggested (H.J. de Grooth, J.-F. Timsit & L. Mermel et al 2020). Although CRBSI is the gold standard, it is infrequent, relatively difficult to diagnose, and false negatives are common because most patients receive antibiotics. CRBSI was

associated with catheter colonization, but not with treatment effect, so it could not be used as a good proxy for treatment effect.

4 Cause and risk factor of central venous catheter-associated bloodstream infections

CRBSI refer to patients with indwelling endovascular devices experience bacteremia and receive at least one positive blood culture through peripheral veins, accompanied by clinical manifestations of infection. There was no other clear source of hematogenous infection except catheter. (Koen, Jochen, Dirk, Stijn & Dominique 2014). According to U.S. CDC guidelines (Guidelines 2011 & Updated Recommendations 2017), the cause of catheter-related blood infection is not only related to the type of catheter, but also related to the procedure, patient condition, placement location, and duration of catheter indwelling.

4.1 Irregularities from operational processes

Before and during catheterization, and during subsequent maintenance, if attention is not paid to aseptic practices, such as hand hygiene, skin disinfection, dressings, etc. It would be the most important cause of infection. This also comes from hospital policies, norms and standards related to the cause of infection (Koen et al 2014). Philippe, Jean-Luc, Elise. Dupuis-Lozeron and Bruce (2019) had concluded using of chlorhexidine (CHG) dressings can significantly reduce central catheter-related infections.

4.2 Type and placement of catheters

The central venous catheter includes non-tunneled central venous catheters, tunneled central venous catheters, peripherally inserted central catheter (PICC) and pulmonary arterial catheters, totally implantable catheters. Among all the vascular catheters, the incidence of infection was higher in the open indwelling catheter and the peripheral catheter with steel needle, while the incidence of infection was lower in the subcutaneous intravenous port and the mid and long peripheral catheter. In terms of the incidence of catheter infection, the infection rate of long-term indwelling tunnel catheter with csa was the highest, and that of peripheral venous indwelling needle was the lowest (Guidelines 2011 & Updated Recommendations 2017). So, most CRBSI are associated with non-tunneled central venous catheters in the CVC. Totally implantable catheter had the lowest incidence of catheter-related hematogenous infections, and patients felt good about themselves without the need for local care. But surgery is needed to remove the catheter.

CRBSI is also related to setting place. Vassiliki, Petros, Ioannis, Elsa, Ioannis, George and Athanasios (2020) compared CRBSI and catheter colonization rates at subclavian (SC), internal cervical (IJ), and femoral artery (FEM) insertion sites in hospitalized patients. Meanwhile, the

distribution and drug resistance of pathogens at these three loci were analyzed. It showed that FEM insertion was associated with higher rates of bloodstream infection and catheter colonization compared with IJ and SC sites. In addition, the location of catheterization is also related to infection bacteria and drug resistance.

4.3 Patient's condition

Factors such as prolonged use of a central venous catheter (CVC), different catheter materials, such as polyethylene catheters, tend to cause platelet adhesion, which increases the risk of infection. In addition, the placement of the catheter, the procedure of the catheter, and the aseptic techniques used during catheter maintenance all influence the incidence of catheter-related hematogenous infections.. Catheter-related infections are also associated with diseases and conditions associated with the patient (e.g., immune deficiency, renal replacement therapy) (Vassiliki et al 2020).

According to a German guideline for cancer and bloods diseases CRBSI (Boris, Enrico, Dieter, Justin, Michael Til, Ramon, Matthias, Michael, Philippe, Annika, Sibylle, Bernd, Olaf, Markus, Maria, Florian, Hans-Heinrich, Meinolf & Marcus 2021), because cancer patients need long-term chemotherapy, the damage of chemotherapeutic drugs to peripheral blood vessels makes the central venous catheterization approach become the vein of choice for chemotherapy. Moreover, cancer patients are particularly susceptible to immune suppression related to disease and treatment. These all increase the risk of infection.

5 Prevention methods

According to Thl (2020), healthcare-associated bloodstream infections have been on the rise in recent years, there are an estimated 100 000 cases that are reported in Finland annually, with about 50% happening in hospitals and the remaining half in long-term care, and which result in 1 500 - 5 000 deaths each year.

Dimick et al. (2001) conclude that the cost of these infections is enormous, both in terms of the chance of morbidity and in financial aspects. In preventing infections, healthcare providers, administrations, as well as patients and insurers, should have a strong interest in decreasing the rate of these infections for improving patient recovery, and reducing health care costs.

The Centers for Disease Control and Prevention (2011) and the National Health Service (NHS) have developed a set of guidelines for infection prevention. Infection prevention can be divided into three parts. The first part is designed for healthcare professionals to take

basic precautions to prevent CLABSI. The second part is for measures to be taken to prevent CLABSI when encountering a patient with or suspected of having an infectious agent. The third part is designed for patients so that they can better protect themselves from CLABSI infection.

The goal of a productive infection prevention program is to eliminate CRBSI from the care of patients. While this is challenging, success in the goal also enhances patient safety, which also requires sustained effort. Given the diverse patient population, the bacterial environment inside and outside each patient, and the limitations of current technology, the goal of the infection prevention program discussed herein is to minimize infection rates as much as possible. (Calfee, 2015)

5.1 Standard precautions

Transmission of microorganisms can occur through hand contact, either person-to-person or person-to-environment. There is evidence that transmission of pathogens through the hands of healthcare workers is a major factor in hospital infection outbreaks. In CVC care, these germs can become infected if transferred to a vulnerable site, such as an invasive device or wound, and the infection can put the patient's life at risk. Therefore, healthcare workers should use liquid soap and water or alcohol-based handrub (ABHR) to wash their hands in many settings, especially in CVC care. For example, hand hygiene before and after catheter insertion, and before and after examining, changing, and dressing intravascular catheters is very effective in preventing CLABSI. (HICPAC, 2011) Effective hand hygiene can significantly reduce the number of germs on the hands, thereby reducing the rate of infection and thus morbidity and mortality in patients. (Loveday et al. 2012)

All patients and their body fluids should be considered as potential sources of infection (Louise, Karen & Sharon, 2013), and PPE should be used to better protect healthcare workers and patients from cross-contamination of microorganisms, regardless of whether the patients or their body fluids they come into contact with at work have any symptoms (Loveday et al., 2012). The use of personal protective equipment (PPE) is an important part of infection prevention. PPE includes aprons, gowns, gloves, goggles, and face masks/respirators, with gloves being the most commonly used. Gloves should be worn during the insertion, replacement, repair, or dressing of intravascular catheters in CVC care, and other PPE such as sterile gloves, goggles, and aprons should be used as appropriate. (HICPAC, 2011)

A sharp instrument is defined as a needle, blade or other sharp medical device that can cut open or pierce the skin. A sharp instrument injury refers to a medical incident in which a sharp instrument punctures or cuts through the skin. Proper handling of needles and other sharp instruments is the paramount aspect of the lowering of the risk of CLABSI, because once

a sharp instrument injury occurs, external bacteria and microorganisms can enter the body along the wound and cause infection, so health care workers should pay attention to operational safety when using needles and other medical devices and should not recap the needles. (Loveday et al. 2012)

5.2 Transmission-based precautions

In the handling of patients with known or suspected certain infectious agents, transmission-based precautions are necessary in addition to standard precautions. Transmission-based infections are defined as contact, droplets and airborne infections. These actions have been shown in practice to be effective in reducing CLABSI. (CDC, 2016)

5.2.1 Contact precautions

Exposure precautions is used when in contact with a patient known or suspected to be infected and at increased risk of exposure to transmission. First, to control pathogens, use personal protective equipment such as gloves and gowns when there is contact with patients or their environment. And discard in an appropriate way after leaving the ward. Second, it is necessary to place the patient in a separate space whenever possible, to limit the patient's movement outside his or her room to prevent the spread of infection, and to cover specific areas of the patient's body when it is necessary to transfer the patient. Third, use disposable or patient-specific care equipment, and if common use with others cannot be avoided, clean and disinfect it before and after use. Finally, clean and disinfect the patient's room, especially surfaces and equipment that are frequently touched near the patient. Aseptic skin preparation and catheter access are also essential in CVC care. Skin antiseptics consist of iodine based solution and ethyl as well as chlorhexidine gluconate are used during skin preparation prior to CVC insertion. The use of these skin disinfectants is effective in reducing the risk of intravascular catheter-related infections. (CDC, 2016)

5.2.2 Droplet precautions

Droplet precautions is widely used in patients who are known or suspected to be infected with pathogens transmitted through respiratory droplets. First, the most important aspect of droplet precautions is the control of the source of infection by wearing a mask for the patient whenever possible, or if a mask cannot be worn, by knowing that the patient is following respiratory hygiene/cough etiquette. Second, as with contact precautions, patients should be placed in a separate environment as much as possible to reduce the potential for transmission. Third, health care workers also need to wear appropriate personal protective equipment and must wear masks when interacting with patients to prevent transmission of respiratory secretions from the patient. (CDC, 2016)

5.2.3 Airborne precautions

Airborne precautions are necessary if a patient has confirmed or suspected infection with a virus that can be transmitted by the airborne route, such as tuberculosis. Airborne precautions are basically the same as the above two precautions, such as proper use of personal protective equipment, wearing a mask, and housing the patient in a separate space. The difference is that health care workers need to wear appropriate respirators when in contact with patients to completely isolate airborne sources of infection and to place patients in negative pressure rooms when available to reduce the potential for airborne transmission. However, the air environment also has a very important impact on CVC care, such as the control of wound infection at the puncture site. (CDC, 2016)

5.2.4 Precautions during the maintenance period

The healthcare professionals should check the patient's need for central line daily and remove any central line that is not needed immediately. If a central line needs to be replaced, the catheter, injection site and should be disinfected. And for administration products other than lipids or blood products, it all should be changed every 96 hours. (Bell & O'Grady, 2017)

5.3 Patient education

Patient education is also an extremely important part of CLABSI control, as patients have the most intuitive experience with the catheter and its surrounding area. Patients should first have a good understanding of CLABSI, ask the appropriate health care worker if they do not know anything, watch for moisture or stains on and around the bandage, be careful not to wet the insertion site and its surroundings to reduce the potential for bacteria, watch for signs of redness or pain in the area around the catheter, do not allow other non-caregivers to touch the catheter, and visit the patient during Everyone must wear appropriate personal protective equipment and proper hand hygiene when visiting patients, and tell patients to notify health care providers if they are uncomfortable in any way.1 (CDC, 2011)

5.4 Nurse's perspective

Nurses are often exposed to varying degrees of infection in the course of their care. Nurses spend most of their time working directly with patients and are prone to infecting patients, especially those who also have a central line, due to exposed wounds they are more vulnerable to infection. (Kosgeroglu et al. 2004)

According to Joukar & Taherri (2007), nurses play a key role in patient care for infection control and are one of the most important members in controlling the spread of infection within the hospital, therefore, nurses should have good knowledge and skills in infection control.

6 Result

We searched Medic, Joanna Briggs (Ovid), ProQuest, PubMed, Cinahl with Fulltext (EBSCO), and Cochrane Review databases. A total of 25 references were cited. The authors come from different departments. See table 3 below :

Author, year, country	Purpose of the study	Topic	Data collection method	Data analysis method	Main result/ conclusion
Philippe E, Jean-Luc Pagani, Elise Dupuis-Lozeron, Bruce Ekholm MS, et al. 2019 Switzerland	The objectives of the study were to assess whether the progressive introduction of CHG dressings to an ongoing catheter bundle could further reduce the rate of catheter-associated bloodstream infections and to compare the effectiveness of two different types of CHG dressing (CHG sponge + transparent dressing versus CHG gel all-in-one dressing) on the rate of catheter-associated bloodstream infection.	Sustained reduction of catheter-associated bloodstream infections with enhancement of catheter bundle by chlorhexidine dressings over 11 years.	As part of the routine and mandatory data collection. and hospital length of stay and mortality were prospectively collected For each patient.	Demographic characteristics are analyzed by descriptive statistical methods, such as mean, percentage, etc. The incidence density rates were tested using a Poisson regression model. Used a Cox proportional hazards regression model with catheter-days representing the time factor and CABSIs as the event of interest.	1. 111 CABSIs had recorded. 2. The CABSIs rate dropped from 1.48 cases without CHG dressings to 0.69 cases with CHG sponge and 0.23 cases with CHG gel dressings. 3. A non-significant lower rate of infections occurred with CHG gel compared with CHG sponge dressings.
Hideto Yasuda, Masamitsu	To compare the efficacy of three	Comparison of the efficacy of	Adult patients	The data is presented as	1. Catheter-tip

<p>Sanui, Takayuki Abe, et al.</p> <p>2017</p> <p>Japan</p>	<p>antiseptic solutions [0.5%, and 1.0% alcohol/chlorhexidine gluconate (CHG), and 10% aqueous povidone-iodine (PVI)] for the prevention of intravascular catheter</p>	<p>three topical antiseptic solutions for the prevention of catheter colonization.</p>	<p>undergoing central venous or arterial catheter insertions were randomized to have one of three antiseptic solutions applied during catheter insertion and dressing changes. The primary data was the incidence of catheter colonization, and the secondary data was the incidence of catheter-related bloodstream infections (CRBSI).</p>	<p>the mean with standard deviation (SD) or median with interquartile range (IQR) or continuous variables and percentages for categorical variables. One-way analysis of variance (ANOVA) and the Kruskal–Wallis test or χ^2 test and Fisher’s exact test, incidence of catheter colonization and CRBSI were compared among the three groups using the log-rank test.</p>	<p>colonization incidence was 3.7, 3.9, and 10.5 events per 1000 catheter-days in 0.5% CHG, 1% CHG, and PVI groups, respectively (p=0.03)</p> <p>2. Pairwise comparisons of catheter colonization between groups showed a significantly higher catheter colonization risk in the PVI group.</p> <p>3. Sensitivity analyses including all patients by multiple imputations showed consistent quantitative conclusions.</p> <p>4. No significant differences were observed in the incidence of CRBSI between groups</p>
<p>Krikava I, Kolar M, Garajova B, Balik T, et al.</p> <p>2020</p> <p>Czech Republic</p>	<p>The aim of this study was to examine the efficacy of a catheter with a non-leaching antimicrobial</p>	<p>.The efficacy of a non-leaching antibacterial central venous catheter - a prospective,</p>	<p>The study was conducted in two centers using a prospective</p>	<p>Primary parameters were analyzed with confirmative statistical tests and the</p>	<p>While the rate of catheter colonization between the coated and uncoated CVC (17.4% vs.</p>

	coating against catheter colonization and bloodstream infections (BSI).	randomized, double-blind study.	randomized, double-blind and controlled design (680 intensive care patients; a protective CVC (Certofix® protect) or a standard CVC (Certofix®). Primary objectives were the rates of catheter colonization and BSI in the two groups. Other baseline demographics, APACHE II score, insertion site, location of CVC placement (ICU or theatre), indwelling time and length of ICU stay were comparable for both groups.	usual descriptive statistical methods. All statistical tests were performed two-sided with a significance level of $\alpha=0.05$. Fisher's exact test was used for two tables while for all other contingency tables the χ^2 -Test was used. For the analyses of continuous parameters, the groups were compared with the t-test.	18.7%, $P=0.7477$) and the rate of microbiologically confirmed catheter associated infections were similar (1.4% vs. 1.9%, $P=0.7521$), the coated CVC showed a significantly lower incidence of BSI (2.0% vs. 6.5%, $P=0.0081$) and a significantly lower mean incidence of BSI per 1000 catheter days (3.2 vs. 8.3, $P=0.0356$).
Vassiliki P, Petros K, Ioannis B, et al. 2020	The aim of the study was to compare CLABSIs and catheter colonization	Central venous catheter-related bloodstream	Data was collected on 1414 CVCs and	Performed a retrospective analysis of data collected prospectively	FEM site of catheter insertion was associated with a higher

Greece	rates among the three catheter insertion sites: subclavian (SC), internal jugular (IJ) and femoral (FEM) in hospitalized patients. Moreover, to analyze the distribution of pathogens and their antimicrobial resistance profiles at these three sites, concurrently.	infection and colonization: the impact of insertion site and distribution of multidrug resistant pathogens	13,054 CVC-days.	from all catheterized patients at a tertiary care Greek hospital from May 2016 to May 2018	rate of bloodstream infection and catheters' colonization compared to IJ and SC sites. Furthermore, this survey highlights the changing trend of the distribution of frequent pathogens and resistance patterns towards MDR Gram-negative pathogens, underscoring the need for consistent monitoring of antimicrobial resistance patterns of these specific infections.
Naomi P. O, Grady, M.D, Mary Alexander, R.N. et al. 2011 & 2017 Updated Recommendations U S CDC	Guidelines for health workers who insert endovascular catheters and those responsible for monitoring and controlling infections in hospitals, outpatient clinics and home health Settings.	Guidelines for the Prevention of Intravascular Catheter-Related Infections	Collect all kinds of literature and trial reports related to intravascular catheter infection prevention.	An evidence-based approach to analysis	A total of 20 recommendations were summarized, such as training, aseptic techniques, puncture site selection, barriers, etc.,
H.J. de Grooth, J.-F. Timsit, L. Mermel, et al. 2020	The aim of this study was to determine the validity of different	Validity of surrogate endpoints assessing central venous	(a) Individual-catheter data were collected	CRBSI was used as the gold-standard endpoint, for which	CLABSI should be used in the routine setting for surveillance

Netherlands and France	endpoints for central venous catheter infections.	catheter related infection: evidence from individual- and study-level analyses	from 9428 catheters from four large RCTs; (b) study-level data from 70 RCTs were identified with a systematic search. Eligible studies were RCTs published between January 1987 and October 2018 investigating various interventions to reduce infections from short-term central venous catheters or short-term dialysis catheters.	colonization, CAI and CLABSI were evaluated as surrogate endpoints. Surrogate validity was assessed as (1) the individual partial coefficient of determination (individual-pR2) using individual catheter data; (2) the coefficient of determination (study-R2) from mixed-effect models regressing the therapeutic effect size of the surrogates on the effect size of CRBSI, using study-level data.	purposes while the CRBSI is preferred for clinical research.
Koen Blot, Jochen Berghs, Dirk Vogelaers, et al. 2014. Belgium	Examines the impact of quality improvement interventions on central line-associated bloodstream infections in adult intensive care units.	Prevention of Central Line-Associated Bloodstream Infections Through Quality Improvement Interventions: A Systematic Review and Meta-analysis	Studies were identified through Medline and manual searches (1995–June 2012)	Meta-regression assessed the impact of bundle/checklist interventions and high baseline rates on intervention effect.	Quality. Improvement interventions contribute to the prevention of central line-associated bloodstream infections. Implementation of care bundles and checklists

					appears to yield stronger risk reductions.
Boris Böll, Enrico Schalk & Dieter Buchheidt et al.2021. Germany	This guideline supports Clinicians and researchers alike in the evidence-based decision-making in the management of CRIs in cancer patients.	Central venous catheter–related infections in hematology and oncology: 2020 updated guidelines on diagnosis, management, and prevention by the Infectious Diseases Working Party (AGIHO) of the German Society of Hematology and Medical Oncology (DGHO)	After conducting systematic literature searches on PubMed, Medline, and Cochrane databases,	Summarize recommendations on definition, diagnosis, management, and prevention of CRIs in cancer patients including the grading of strength of recommendations and the respective levels of evidence.	The guidelines summarize recommendations regarding the definition, diagnosis, management, and prevention of cancer CLABSI in patients. Replaces the old guidelines on CRSAI for cancer patients and adds specific recommendations for cancer patients in addition to institutional and regulatory guidelines
Yu He, Huihan Zhao, Yan Wei, Xiao Gan, et al. 2019 China	This study was performed to provide epidemiological information on microbial colonization in central venous catheters (CVCs)	Retrospective Analysis of Microbial Colonization Patterns in Central Venous Catheters, 2013–2017	Bacterial culture and blood culture samples at the tip of CVC catheter were collected from January 2013 to October 2017 when they were sent to the trial.	SPSS version 17.0 software package (Chicago, IL, USA) was used to input and analyze the data. Positive catheter tip, blood culture rates, and cultured fungal and bacterial epidemiological characteristics were	The most common organisms in causing CLABSI were Acinetobacter (23.4%), S. aureus (13.1%), and Candida albicans (12.1%). Conclusion. *e prevalence of microbial colonization in CVCs is still significant and even has

				evaluated. Fisher's exact test or chi-square test was used to test if differences existed between different related factors. $P < 0.05$ was considered significant	gradually changed over time. *e study provides a new view of microbial colonization pattern in CVCs and a prevalence of CLABSI, which will facilitate catheter-related infection prevention and control in clinic.
Han Xu & Yujia Wu 2017 Finland	The goal of this paper is to do a good job in the safety of catheterization nursing, while providing treatment for patients, to protect the safety of patients and their own. Reduce the incidence of central venous catheter infection. Reduce patient suffering and unnecessary waste.	Central venous catheter care and prevention of infection	Because this is a review paper. Therefore, the data collection method is to obtain data through a large number of reading and screening of papers on relevant websites. The databases that were used by authors are CINAHL, ABI INFORM, and OVID. These 3 databases provided them	It includes the quality of data, statistical data analysis, modeling and interpretation of results. (Tartu Ulikool 2015.) To ensure validity, only 10 articles were used in analyzing.	Aseptic techniques should be emphasized in every nursing intervention, safety of equipment must be ensured, new antimicrobial techniques and some medications or nutritional management may be considered. These strategies include antimicrobial agents such as antibiotics, needle-free intravenous entry devices with silver or chlorhexidine, and intravenous

			plenty of reliable articles that they could analyze and get useful information.		dressers with chlorhexidine.
Amanda J. Ullman, Debbie A. Long, Claire M. Rickard 2014 Australia	To assess nursing knowledge of evidence based guidelines to prevent catheter-related bloodstream infections; the extent to which Australia and New Zealand paediatric intensive cares have adopted prevention practices; and to identify the factors that encouraged their adoption and improve nursing knowledge.	Prevention of central venous catheter infections: A survey of paediatric ICU nurses' knowledge and practice	Cross-sectional surveys using convenience sampling. Between 2010 and 2011, the 'Paediatric Intensive Care Nurses' Knowledge of Evidence-Based Catheter-Related Bloodstream Infection Prevention Questionnaire' was distributed to paediatric intensive care nursing staff and the 'Catheter-Related Bloodstream Infection Prevention Practices Survey'	Because of the use of an on-line survey tool, there were no missing data. Continuous variables were described as mean, range and standard deviation values. Categorical data were described using frequencies and percentages. After assessing the normality of distribution in the data, relationships between total scores, safety culture and demographics were assessed by analysis of variance (ANOVA) and Pearsons correlation coefficient (Fields, 2009). Variables with $p < 0.05$ were	The questionnaires were completed by 253 paediatric intensive care nurses (response rate: 34%). The mean total knowledge score was 5.5 (SD = 1.4) out of a possible ten, with significant variation of total scores between paediatric intensive care sites ($p = 0.01$). Other demographic characteristics were not significantly associated with variation in total knowledge scores. All nursing managers from Australian and New Zealand paediatric intensive care

			was distributed to nurse managers to measure knowledge, practices and culture.	considered significant. Statistical analysis was performed using Statistical Package for Social Sciences for Windows 17.0 (SPSS, Chicago, IL).	units participated in the survey (n = 8; response rate: 100%). Wide practice variation was reported, with inconsistent adherence to recommendations. Safety culture was not significantly associated with mean knowledge scores per site.
Xiuwen Chi ¹ , Juan Guo, Xiaofeng Niu, Ru He, Lijuan Wu and Hong Xu 2020 China	This study aimed to evaluate Chinese ICU nurses' knowledge and practice of evidence-based guidelines for prevention of CLABSIs issued by the Centers for Disease Control and Prevention, US and the Department of Health UK.	Prevention of central line-associated bloodstream infections: a survey of ICU nurses' knowledge and practice in China	Nurses completed online questionnaires regarding their knowledge and practice of evidence-based guidelines for the prevention of CLABSIs from June to July 2019. The questionnaire consisted of 11 questions, and a score of 1 was given for a correct answer	Continuous variables were described as mean±standard deviation (SD), or range (only for age). After evaluating the normality of the data distribution, the total scores were compared by the Student's independent t-test between two groups. For comparison among three or more groups, the one-way ANOVA was conducted with the Bonferroni post-hoc	Individual total scores were significantly associated with sex, length of time as an ICU nurse, educational level, professional title, establishment, hospital grade, and incidence of CLABSIs at the participant's ICU. Importantly, only 43% of nurses reported always using maximum barrier precautions, 14% of nurses reported

			(total score = 0–11)	pairwise comparisons. Categorical data were presented as number and percentage (%), and compared with the chi-square test or Fisher's exact test (if any expected value ≤ 5 was found).	never using 2% chlorhexidine gluconate for antiseptic at the insertion site, only 40% reported prompt removal of the catheter when it was no longer necessary, and 33% reported frequently and routinely changing catheters even if there was no suspicion of a CLABSI.
Moi Lin Ling, Anucha Apisanthanarak, Namita Jaggi, Glenys Harrington, Keita Morikane, Le Thi Anh Thu, Patricia Ching, Victoria Villanueva, Zhiyong Zong, Jae Sim Jeong, Chun-Ming Lee 2016 Singapore	A surveillance program is recommended to monitor outcomes and adherence to evidence-based central line insertion and maintenance practices (compliance rate) and identify quality improvement opportunities and strategically targeting interventions for the reduction of CLABSI.	APSIC guide for prevention of Central Line Associated Bloodstream Infections (CLABSI)	This document is an executive summary of the APSIC Guide for Prevention of Central Line Associated Bloodstream Infections (CLABSI). It describes key evidence-based care components of the Central Line Insertion and	The Central line maintenance bundle compliance rate is calculated as a percentage of central line insertions per month (%). Run charts can be used to monitor these changes. Run charts are graphs of data over time and are one of the single most important tools in performance improvement. Feedback the data to	CLABSI is one of the most common and yet preventable healthcare associated infections. We recommend hospitals in the Asia Pacific region that have yet to achieve zero CLABSI rates continue surveillance of CLABSIs and implement Central Line Insertion and Maintenance Bundles using quality improvement

			<p>Maintenance Bundles and its implementation using the quality improvement methodology, namely the Plan-Do-Study-Act (PDSA) methodology involving multidisciplinary process and stakeholders. Monitoring of improvement over time with timely feedback to stakeholders is a key component to ensure the success of implementing best practices.</p>	<p>relevant clinical groups so that targeted CLABSI prevention and control measures can be introduced and reported on.</p>	<p>approaches to improve practices as described in the APSIC Guide For Prevention Of Central Line Associated Bloodstream Infections (CLABSI).</p>
<p>Stacey Paplawski 2020 Australia</p>	<p>The aim of this literature review is to explore and identify evidence-based prevention strategies for central line-associated bloodstream infections in neonates.</p>	<p>Prevention of central line-associated bloodstream infections in the neonatal T intensive care unit: A literature review</p>	<p>A literature search was conducted to locate primary research studies using CINAHL, Medline Complete,</p>	<p>When assessing the quality of evidence, consideration was given to study design, limitations and risk of bias. Although randomised</p>	<p>Thematic analysis of the literature revealed four effective prevention strategies: central line care bundles, consistent education,</p>

			<p>Cochrane Library and PubMed electronic databases. The key words included in the search were: 'central line associated bloodstream infection OR CLABSI', 'NICU', 'neonates OR preterm OR infant OR newborn' and 'prevention strategies'. MeSH terms and the Boolean operators 'OR' and 'AND' were utilised as well as a free text search to ensure a rigorous and comprehensive literature search.</p>	<p>controlled trials (RCTs) are highly rated on the hierarchy of evidence pyramid, RCTs are not always the most appropriate study design to address research topics, particularly when there are significant ethical considerations for control groups.</p>	<p>regular surveillance and dedicated vascular access teams. Evidence suggests that a combination of these evidence-based interventions is the most effective strategy; however, future research is required to establish the preferred skin antiseptic and to continue exploring new prevention strategies.</p>
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Table 3 Literature Review data chart results

As can be seen from the table, the authors of the literatures analyzed in this paper come from 13 countries and regions. The author's background includes nursing administration, clinical nursing, surgery, laboratory, anesthesiology, and intensive care medicine. he purpose

of this study is to focus on the prevention methods and theories of bloodstream infection related to vascular catheterization. Research methods include randomized, double-blind controlled trials, evidence-based analysis, meta-analysis, etc. Prevention methods include management before and during catheterization, selection of catheterization site, application of Chlorhexidine dressing, maintenance after catheterization, etc.

7 Conclusion

With the development of medical and clinical nursing practice, a variety of methods have been developed to prevent bloodstream infections associated with central venous catheters. Evidence-based nursing practices make prevention more strategic. Care before, during, and after catheterization is a long-term and individualized process. There are standard prevention strategies that also take into account individual factors such as disease and physical conditions. Through literature review, some new theories also provide theoretical basis for nursing practice.

7.1 Prevention of bloodstream infections associated with central venous catheters requires multidisciplinary collaboration

As can be seen from Table 2, many clinical departments have carried out studies related to the prevention of central venous catheter bloodstream infection. Not just clinical care, but other departments such as nursing administration, ICU, surgery, laboratory, hematology and oncology, and other non-critical care departments. And carried out various studies from different perspectives and directions. This is related to the increasing use of central venous catheters and the difficulty of infection control and catheter maintenance. Therefore, the prevention of central venous catheter-related bloodstream infections requires multi-department cooperation to achieve the goal of reducing the incidence of infection.

7.2 The goal of an effective prevention program should be to minimize CRBSI as much as possible

Although the ULTIMATE goal of infection prevention is to reduce the incidence of CRBSI to zero in all care units (Guidelines 2011 & Updated Recommendations 2017), but that is a challenging goal. Generally speaking, patients who need central venous catheterization are specific patient groups, and there are some underlying diseases, such as imbalance in the internal environment of the body, resistance to bacteria and immune system problems. It's a vulnerable group of people. In the research on the relationship between the catheterization site and colonization bacteria, Vassiliki et al (2020) proposed the distribution of pathogenic bacteria related to bloodstream infection and the trend of drug resistance pattern. Multi-drug resistant Gram-negative bacteria have emerged as the most important surveillance and

prevention strategy for infection control. And because of the prevalence of microorganisms in the human environment and the limitations of current strategies and techniques, the current goal is to reduce infection rates to the lowest possible level.

7.3 Correlation between catheter colonization and bloodstream infection

Catheter colonization is an important monitoring index to study catheter-related bloodstream infection. Because this indicator reflects the infection situation at the catheter entrance, it is easy to monitor. However, there is controversy, and some studies suggest that catheter colonization is not associated with the therapeutic effect of CRBSI. CRBSI was associated with catheter colonization, but not with treatment effect, so it could not be used as a good proxy for treatment effect. However, the study of catheter colonization provides a theoretical basis and evidence-based method for our clinical nursing measures to prevent central venous bloodstream infection.

In conclusion, with the development of evidence-based nursing practice, prevention of central venous associated bloodstream infection needs to cooperate with multiple departments to achieve the ultimate goal of preventing bloodstream infection from an evidence-based perspective and based on guidelines

8 Reliability, limitations and ethics

When we collect information from literatures, we will only use published book materials, web-based materials from libraries on the internet, and materials from government or trusted organizations as the basis for our literature. In addition, we found many similarities in the literature on prevention methods to prevent central line-associated bloodstream infections in different countries and different ethnic groups at different times, which proves that the method has a high reliability.

There are limitations and considerations of ethical issues in this article. The authors of this thesis are three individuals, each of whom may have a slightly different understanding of this thesis and may have written it with their own focus and may have failed to take note of certain issues, and the authors' inexperience in academic research may have affected the quality and results of the study. Although the inclusion and exclusion criteria were described in this thesis, it is possible that the authors' inadequate consideration resulted in a selection of literature that would have impacted the reliability of the paper. No real patient names, as well as information, appear in this paper; the data for this thesis were collected from sources that were available to all.

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