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An Analysis of the Central Venous Catheter Care Guideline Using the AGREE Tool

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Abstract

A central venous catheter is a catheter that leads directly to the heart. It is most commonly used in the intensive care unit to monitor vital hemodynamic status or administer fluids and blood to the very ill. It can also be used for plasma exchange, apheresis, and nutritional support. Catheter related infections (CR-BSIs) account for health care associated infections in the millions of

dollars. Infection generally occurs because of the body's own production of bacteria and an exposure to these bacteria at point of entry into the catheter. Central venous catheters (CVCs) are indispensable in the intensive care unit (ICU). Central venous catheter related infections account for $296 million-$3.2 billion in health care dollars annually [1]. Guidelines for care and prevention of infection on insertion and during use are recommended by the Centers for Disease Control (CDC) and the Agency for Health Care Research and Quality's (AHRQ) National Guideline Clearing House. Guidelines have been developed to assist practitioners in avoiding infection related to intravascular catheter use, and provide suggestions for their care and use. Using the AGREE tool, a guideline for the care of central venous catheters was examined in this paper. A reduction of the number of bloodstream related infections was shown to be a result of the effective management of central venous catheters. Using alcohol chlorhexidine is the most important factor in maintaining a site free from infection. Inclusion of the AGREE tool is done as an appendix to the article.

***Keywords*:** Infectious Diseases, Nursing, Public Health Management, Health Promotion, Evaluation and Intervention, Central Venous Catheters

Introduction

Domain I: Definition

A central venous catheter is a catheter that leads directly to the heart. It is most commonly used in the intensive care unit to monitor vital hemodynamic status or administer fluids and blood to the very ill. It can also be used for plasma exchange, apheresis, and nutritional support. Catheter related infections (CR-BSIs) account for health care associated infections in the millions of dollars. Infection generally occurs because of the body's own production of bacteria and an exposure to these bacteria at point of entry into the catheter [2]. Central venous catheters (CVCs) are indispensible in the intensive care unit (ICU). Central venous catheter related infections account for $296 million-$3.2 billion in health care dollars annually [1]. Guidelines for care and prevention of infection on insertion and during use are

recommended by the Centers for Disease Control (CDC) and the Agency for Health Care Research and Quality's (AHRQ) National Guideline Clearing House. Guidelines have been developed to assist practitioners in avoiding infection related to intravascular catheter use, and provide suggestions for their care and use. It is important for practitioners however, to realize what guidelines meet evidence-based criteria and what guidelines do not. According to DiCenso, Guyatt, and Ciliska [3], guideline developers must consider relevant patient groups, management options, as well as all important consequences. Guidelines help practitioners practice evidence-based medicine. Using the right guideline is essential to good evidence-based practice.

The potential for CVCs to cause infection has been studied in several studies. At least 15 million CVCs are in use daily in the United States [1]. To improve CVC care and decrease infection rate, a guideline for the care and use of CVCs has been developed by the CDC [1] to give practitioners an evidence-based practice perspective in which to practice safe use and care of CVCs. There are only several bacteria that cause infection: Staphylococcus epidermis, Staphylococcus aureus, Enterococcus spp, Klebsiella, pseudomonas, Escherichia coli, serratia and Candida. A snapshot survey of HCAIs conducted between September and November 2011 by the Health Protection Agency revealed that 6.4% of all patients in hospital had an HCAI (six patients out of every 100), but bacteraemia was not in the top three most prevalent infections. This survey also showed significant reductions in the most common bacteraemia since 2006, with methicillin resistant Staphylococcus aureus (MRSA) bloodstream infections down from 1.3% to less than 0.1% of patients. Clostridium difficile (C.difficile) infections were down from *2%* to 0.4%. These statistics show a continuing downward trend in line with increasing activities to reduce HCAIs and CR-BSIs. Most literature indicate that a positive culture and a positive catheter end will result in systemic infection [2]. More aggressive need for guidelines to care are necessary to prevent infection and further reduce the incidence of infection.

The objective of the National Guideline Clearinghouse guideline is well-written and concise. The purpose of the guideline and the expected benefits are also outlined clearly. For

example, the guideline covers all CVCs, including femoral, subclavian, internal jugular, peripheral, and peripherally inserted central catheters (PICCs). The length of time the catheter has been in contributes to the possibility of infection [4]. The first paragraph defines what might be called a blood stream infection (BSI) and how BSIs can be excluded by examination of the patient's record. According to Craig and Smyth [5], once a guideline has been defined, it has to be developed to answer a host of key clinical questions. A detailed literature search is necessary for the guideline to be practical. The National Guideline Clearinghouse [4] guideline states that health care professionals should know the difference between surveillance definitions and clinical definitions. This paper will examine outcomes-based guidelines on CVC care using an outcomes-based tool.

Health Question Specifically Described

There is no clinical question defined by the guideline. However, the clinical definitions of catheter-related infection are included in a separate paragraph in the opening section of the National Guideline Clearinghouse [4] guideline. The interventions necessary to prevent CVC infections are outlined in paragraph format in the guideline. For example, hand washing and aseptic technique is number one at reducing the chance of an infection. The descriptions are clear and concise. The item content is easy to find. Every intervention is listed in paragraph format in detail. There is enough information to format a guideline for the practitioner. For example, skin antisepsis is one part of the guideline. In this section, a paragraph devoted to skin antisepsis gives details on the use of providone iodine as the most widely used antiseptic for cleansing CVC insertion sites. However, in other studies, the use of chlorhexidine gluconate lowered CR-BSI rate compared with providone iodine [4]. Best practice in many critical care units is to use chlorhexidine gluconate [6, 7]. The use of this guideline in evidence-based practice is ongoing in many critical care units [6-8].

The population is specifically described in the guideline. Adult and pediatric patients

with central venous catheters are the target population and are clearly outlined in the guideline. The target population includes those patients with intravascular, peripheral, and PICC lines [4]. Pediatric guidelines are addressed separately. The guideline can be used to apply to a variety of populations.

In Switzerland a tertiary care hospital conducted a multidisciplinary study to determine the best method for preventing infection in central catheters. After meeting and studying over 300,000 patients with CVCs, a detailed insertion protocol was developed and a detailed care protocol has been established. Carts were established and served as workable tables for products such as insertion trays. Alcohol-based chlorhexidine has been the primary cleaning method used during the study [9].

Domain II: Stakeholder Involvement

The Developers are from Relevant Groups

The National Guideline Clearinghouse [4] guideline developers list is comprehensive. The list includes agencies such as the CDC, the Infectious Diseases Society of America, Infusion Nurses Society, Pediatric Infectious Diseases Society, Surgical Infection Society, American College for Chest Physicians, and more. The comprehensive list of developers adds relevancy and credibility to the guideline as many professionals had input into putting the guideline into place. Craig and Smyth [5] suggest that a guideline with a comprehensive list of developers has credibility as well as validity. The group of developers should include a list from all relevant groups to be all-inclusive to ensure a balanced approach. There is a fair representation from several related disciplines giving balance and validity to the guideline. Table 1 shows a comparison of cases with and without bloodstream infections [10].

The Views and Preferences of the Target Population have been sought

No views of the target population were sought during the development of the guideline. No studies were done to include the target population in the guideline [4]. According to Craig

Table(1): Comparison between cases with central line associated bloodstream infection (CLABSI) and cases without CLABSI

Variables	No (%) of cases with CLABSI	Univariate	Miltivariate
Type of catheter		0.888	
Central venous catheter	5 (0.90)		
Double lumen catheter	1 (0.77)		
Hand hygiene			
Yes	6 (0.87)		
No	0 (0.0)		
Site of infection		0.679	
Femoral site	3 (2.95)		
Non-femoral site	3 (0.70)		
Use of 2% CHG		0.871	
Yes	6 (0.87)		
No	0 (0.0)		
Maximal sterile barrier	3 (0.5)	**0.030**	**0.005**
Yes	3 (0.5)		
No	3 (3.45)		
Complete of four bundle		0.416	
Yes	2 (0.53)		
No	4 (0.66)		
Inserted by intensivists		**0.010**	**0.030**
Yes	3 (0.48)		
No	3 (5.00)		
Category		**< 0.001**	0.220
Medicine	2 (0.39)		
Surgery	2 (1.37)		
Cardiovascular	2 (7.41)		

Bold type indicates statistical significance with $p < 0.05$.

and Smyth, patient involvement is important to formulating evidence-based guidelines and is no different than any other patient-related process. Patient's experiences with illness, use of CVC, monitoring, and understanding make them key people for use in guideline development. However, patient involvement in guideline development is rare. Soliciting information in a group environment may be beneficial to a guideline development [5].

The Target Users are Clearly Defined

The target users are clearly defined by the guideline. Target users include anesthesia, critical care, infectious disease, internal medicine, nursing, pediatrics, pulmonary medicine, and others. The guideline has been written for anyone managing CVCs. The target users are clearly laid out by specialty and are appropriate for this guideline [4].

Domain III: Rigour of Development

Systematic Methods were used to Search for Evidence

An electronic search was conducted on PubMed and Medline from 2000 to 2009 using the search terms catheter-related infections, prevention, catheterization, central venous/adverse effects, methods, standards, catheterization, peripheral/adverse effects catheterization, peripheral/methods catheterization, peripheral/standards, handwashing/standards. The number of source documents was not stated [4]. The search criteria appear comprehensive. Unpublished sources were reviewed.

The Criteria for Selecting the Evidence is Clearly Described

Inclusion criteria were listed in this guideline however, exclusion criteria were not. Human studies in the English language were the only inclusion criteria listed. Key words were appropriate and the inclusions were acceptable [4]. Craig and Smyth write that inclusion and exclusion criteria are important because that is how developers communicate how studies were selected. This helps clarify the definition of the guideline and makes the credibility and rigour acceptable if included. Craig and Smyth also write that including inclusion and exclusion criteria is a way of communicating the process by which the guideline was developed, a process the target user may need to know before implementing into practice. A detailed study search may improve the process of finding pertinent literature and add validity to the guideline through supporting literature. Rigorous methods for searching the literature for studies to include involves using specific inclusion criteria such as specific study designs or studies specific to the effectiveness of the treatment [5].

The Strengths and Limitations of the Body of Evidence are Included

The guideline based its recommendations mainly on meta-analyses and systematic reviews using randomized controlled studies and other quantitative studies. A few qualitative studies were also included. There was no mention of study sampling limitations, allocation concealment, or blinding. All studies were appropriate for the outcomes to the guideline [4]. For example, the study by Henry, Plante-Jenkins, and Ostrowska in 2001 "An Outbreak of Serratia Marcescens Associated with the Anesthetic Agent Propofol" is included in the guideline for appropriateness due to its randomized controlled study on patients who experienced an outbreak of the infection after receiving a CVC and Propofol [1]. This study was rated a Category IA (See Appendix B). Many studies have outcomes appropriate for the guideline. There was a consistency of results across the studies, including the use of antiseptics for cleaning and handwashing techniques. There were also studies on the changing of dressings and the studies had similar outcomes. The magnitude of benefit is better than the magnitude of harm for the studies included for the guideline. The studies are applicable to practice and should be considered suitable resources for use as evidence-based practice guidelines [4]. The recommendations were graded according to a rating scheme for strength of recommendation (see Appendix B). For example, educate health care personnel on the use of CVCs is rated a Category IA; in pediatric patients the upper or lower extremities or the scalp can be used as the insertion site is rated as a Category II [4]. According to Craig and Smyth, each study is labeled with a level of evidence. This level of evidence is established according to its methodology. Studies with an appropriate design, study sample, and are methodologically sound can be included in the guideline [5].

The Methods for Formulating the Recommendations are Clearly Defined

Reaching a conclusion for recommendations can occur in a variety of ways. When evidence is considered by the developers, literature can be interpreted in a number of ways. The developers must consider all the methodologies and study designs, come to a conclusion about relevance and judge the appropriateness for the guideline. Where opinions vary, expert

consensus must prevail. There is a grading process that experts then follow. Experts rate based on Level of Evidence and a rating scheme for recommendations. Grading allows experts to address the validity of the guideline [5]. Expert consensus was used to formulate the guideline. There was no mention of the Delphi process or any other method of how the developers reached the consensus [4]. It would have been more helpful to establishing validity to have expounded on the methods for formulating the recommendations.

The Health Benefits, Side Effects, and Risks have been Considered

The health benefits of the guideline include improved patient outcomes and decreased health care costs by reducing the infections associated with CVCs. Proper care and use can lead to safe and effective treatment using a CVC. The potential harms include allergic reactions, the emergence of multi-drug resistant organisms, toxicity, and other unforeseen complications such as these [4].

Explicit Link between Recommendations and Supporting Evidence

There is an explicit link between the recommendations and supporting evidence. Each recommendation has a literature reference linked to it. It is concise and clearly easy to find. It is applicable and supports the data. For example, under the heading “Peripheral Arterial Catheters and Pressure Monitoring Devices for Adult and Pediatric Patients” recommendation number two states “In children, the brachial site should not be used. The radial, dorsalis pedis, and posterior tibial sites are preferred over the femoral or axillary sites of insertion” [4]. After this guideline is the work by Lorente et al. in 2006. This adds weight to the recommendation, letting the practitioner know that the recommendation is not only supported by literature, but what literature it is supported by and where to find the supporting references.

There was no external review of experts prior to publication for the CVC guideline. According to the CDC [1], the group that developed the guideline was composed of a working group of society members from critical care, anesthesia, oncology, pulmonary medicine, and nursing. No other methods were undertaken to review the guideline.

The developers map out a procedure for revision in the 2011 update of the guideline. This guideline is an update from the 2002 version of the existing guideline. A statement was made that this is an updated version and clearly and concisely communicated the new guideline's replacement over the old and new supporting literature was added to the old [4].

Domain IV: Clarity of Presentation

The Recommendations are Specific and Unambiguous

The recommendations are clear and concise. Specific recommendations are targeted to either pediatric or adult patients. Each recommendation is clearly written to the target population. There is no uncertainty in the recommendations. For example, the recommendation "Replace dressings used on short-term CVC sites every two days for gauze dressings" [4] is clearly written with a time frame and distinct instructions on when to change the dressing. Each of the recommendations in the CVC guideline is written similar to this.

The Different Options for Management of the Condition or Health Issue are Clearly Presented

Because this is not a guideline based on the treatment of a disease, this section is hard to define for this guideline. The recommendations for the CVC guideline are directed toward preventing BSIs in adults and pediatric patients. There is no option for different treatments such as antibiotic suggestions. However, there are suggestions for antimicrobial caps, antimicrobial skin wash chlorhexidine for cleansing, and dressing change frequency to prevent complications such as infection. There are also recommendations to prevent infection such as changing the catheter infrequently and within 48 hours if put in emergently [4]. These recommendations are sufficient for management of the prevention of infection if followed closely.

Key Recommendations are easily Recognizable

Key recommendations are grouped together in the CVC guideline. For example, antimicrobial/antiseptic treatment is under one section while recommendation for use is under

another section. The recommendations are easily read and understood. They are applicable to the problem and directly relate to the supporting literature. There is a chart with key recommendations listed and it is easily understood and applicable to the guideline and supporting literature. It outlines the types of catheters and entry sites and what steps need to be taken to prevent infection in each type catheter. Two more charts are available to the practitioner; one is for the type of unit and number of patients with catheters and number of infections and the other is the most common infections associated with CVCs. These charts are applicable to the outcomes of the guideline [4].

Domain V: Applicability

The Guideline Describes Facilitators and Barriers to its Application

There is no mention by developers of the CVC guideline about facilitators or barriers to application. There is a statement in the opening paragraph that reminds practitioners that this guideline is categorized based on scientific data, theoretical data, clinical applicability, and economic impact. The guideline was also developed using specific literature regarding CVC use and categorized (see Appendix B) by the developers. However, barriers to the application are not mentioned other than to note that adverse events such as toxicity, allergic reaction, and the development of multi-drug resistant organisms can be barriers to successful implementation of the guideline [4].

Advice and/or Tools on how the Recommendations can be put into Practice

An implementation strategy was not provided [4]. No links, summaries, or pilot studies are available to immediately access. There is a citation at the end of each recommendation and the practitioner can directly go to the citation using the PubMed or Medline databases, however linking directly from the guideline is not possible. There is the ability to electronically print the guideline for use in clinical practice.

Potential Resource Implications

Guideline developers reviewed cost analyses however they did not elaborate on the

process used or the results [4]. The cost of infection rates in CVCs in the United States (U.S.) was mentioned and the cost of preventing infections in the health care arena is presented [1].

Auditing and Monitoring Criteria

The guideline states that "evidence-based audit criteria will be developed based on this guideline" [4]. Each recommendation has evidence-based literature to support the recommendation. The foundation of evidence-based practice is supported by literature and clear, concise outcomes [5]. There are definitions on when dressing changes should be made, when catheters should be changed, how and where to place catheters in both adult and pediatric patients, and hygiene [4]. There is clear definition of the recommendations and supporting literature.

Domain VI: Editorial Independence

The Views of the Funding Body have not Influenced the Content of the Guideline

The source of funding for the CVC guideline is the U.S. Government. No mention is made as to whether the government influenced the guideline or not. The CDC guideline parallels the National Guideline Clearinghouse guideline and is interchangeable as the basis for the National Guideline Clearinghouse guideline is based on the CDC guideline [4].

Conflict of Interest have been Recorded

There were no efforts made to minimize the risks of conflicts of interest. No mention was made of conflict of interest [4]. There are limitations in the guideline because it is important to note limitations.

Overall Guideline Assessment

Rate the Overall Quality of the Guideline

The quality of the CVC guideline can be rated overall as a five on the AGREE II tool scale of 1-7. This number correlates with a moderate rating. The guideline cannot be rated any

higher because there were important sections missing such as patient input, implementation strategy, facilitators or barriers, and other important sections. The guideline needs more development for easier to increase validity.

Recommend this Guideline for Practice

This guideline could be strongly recommended for practice. As most domains score above 60% (with the exception of Editorial Independence and Rigour of Development). This rating indicates the guideline has a high overall quality and can be applied to practice without modifications or changes. A total score of six can be applied for the AGREE II score. Many ICUs are currently implementing protocols based on this guideline [6-8].

The use of guidelines by physicians and other practitioners is well recorded. Guidelines help in establishing best practice in preventing catheter related BSI. Using the National Guideline Clearinghouse [4] as a basis for policy and protocol development, Cherry et al. [11] authored several important steps in the validation process. For example, using care not to get the central line site wet and using hand hygiene, aseptic technique, and daily review of necessity to name a few. A short video was shown for medical personnel on the insertion of the CVC and nursing personnel were shown a video on the use and care of the line. Cherry et al. [11] found that several factors contributed to the increase in reported and unreported infections. Simple lack of education about what is considered best practice contributes to many failures. While some experienced nurses may be familiar with the guideline, new nurses may need to have assistance in assimilating the data.

The CDC and National Guideline Clearinghouse were used to develop guidelines for the ICU in a large teaching university in the northeast. Because the data was collected at this ICU, there are some considerations such as bed-size and academic affiliation. These aggregate risk-adjusted factors can be used as national benchmarks. The most commonly infective cause of the

BSI is coagulase-negative staphylococci, Staphylococcus aureus (Staph). Staph infections accounted for 19% of all BSI reported [12]. While it is important to critique evidence-based guidelines for applicability, it is also useful to determine their usefulness by measuring outcomes.

Outcome Measures

Rising health care costs are consistently generating more emphasis on health care outcomes. Across the country, organizations are using outcome measures to evaluate clinical guidelines to save money, increase quality of care, and address patient safety. Consumers are determined to receive high quality health care and providers should deliver by implementing cost-effective guidelines. Programs focusing on outcomes measurement have increased over the last decade as a result of the rising costs of health care and the need for efficient health care [13]. It is vital for nurse practitioners and doctoral practitioners to be able to utilize outcome measures to decide which clinical guidelines are valuable and which guidelines are not.

There is no definitive for the term outcome in health care. In general, an outcome is the result of patient care. The terminology used in outcomes measurement is not standardized. The language of one organization can vary significantly from another. Outcomes research includes: (a) comparing the cost/benefit or cost-effectiveness of products, programs, guidelines, or services, (b) examining the impact of new technologies on patients' health status, and (c) identifying certain populations at risk for disease and developing strategy for optimal utilization of health care resources [13].

Conceptual Model

According to Mateo and Kirchhoff [15], the first step in outcomes measurement is to define the conceptual model. For the CVC guideline, a broad conceptual model is needed for definition because the guideline covers a wide scope of interventions. A medical conceptual model such as the diffusion of innovation model can be identified with the guideline using keywords such as central venous catheterization, hand hygiene, antiseptic technique and other

similar keywords [14].

Key relationships must be identified after the conceptual model has been established. The key relationships seen in the CVC guideline are infection to prevention and user to patient. Key terms are antisepsis, site care, site placement, and length of site viability. The recommendations are based on these key terms and outcomes can be measured based on whether the provider has met these recommendations or not [15]. For example, the relationship between the CVC and hand hygiene is that handwashing is the primary method of preventing the spread of infection [1]. Recommendations include washing hands for 15-20 seconds prior to inserting or caring for a patient with a CVC [4]. Recommendations also include scrubbing the hubs of the CVC upon administration of any intravenous (IV) medication prior to and after administration. Research has indicated the results of both these interventions will reduce the number of CVC infections [1]. The relationship between interventions or recommendations is essential to the guideline's success. For example, if the nurse scrubs the hub, the resulting relationship should be a prevention of infection in the CVC.

Data Sources and Measurement Issues

After the conceptual model has been identified and key relationships developed, it is important to next point out data sources for each variable. The ideal data source is valid, reliable, and lends itself to precise measurement [15]. The data sources for the CVC guideline are valid, reliable, and lean toward precise measurement. For example, the work by Rubinson, Haponik, Wu, and Diette in 2003 lists MeSH terms such as catheterization standards, chlorhexidine, guideline adherence, infection control standards, and substances. The terms are valid for the guideline. The annotated bibliography presents a reliable picture of research for use by the developers, and the article leans toward precise measurement as it is a randomized controlled trial [4].

Precise measurement is vital to validating interventions and recommendations because if there are 20 recommendations that cannot be validated by the literature, then the

recommendations fall short of being useful. The CVC guideline recommendations are useful because they have been verified by literature, connected to outcomes by evidence-based research that provides real time proof of viability of outcomes measurement, and the outcomes have been validated by the developers. In developing the recommendations, such as placement of the catheter, researchers conducted trials that determined best practice for practitioners and developers cited these best practices in the guideline.

Episode of Care

The episode of care for the CVC guideline is the patient's stay in the hospital [15]. While some CVCs are utilized outside the ICU, most CVCs are used within the critical care setting. The episode of care would be the critical care stay of the patient. The limitation of this would be an oncology or pediatric patient with a central line. Their stay would not necessarily be in a critical care unit.

Level of Analysis

Since health care is delivered at multiple levels, a level of analysis is necessary to evaluate the outcome of the clinical guideline [15]. In the CVC guideline, the care is dependent on the provider placing the line in the appropriate location, using the approved skin antiseptic, keeping aseptic technique, and the care providers who care for the site daily must adhere to the guideline's basic principles of site care. For example, if the research question was whether the patients who received the treatment of interest had a lower rate of infection than patients who did not, then the level of analysis would be the patient and the data collection. The question would be whether the patients who received the treatment in the guideline actually received a lower infection rate than other patients. The measurable question would be the recommendations in the guideline such as handwashing, site care, and positioning of the catheter. In other words, do the treatments such as handwashing, site care, and positioning contribute to lower infection rates? The Institute for Healthcare has called for initiation of these guidelines to prevent central line infections. The Institute of Healthcare has developed this central line bundle to include five

components: hand hygiene; maximal barrier precautions; chlorhexidine skin antisepsis; optimal catheter site selection (with the subclavian vein as the preferred site for non-tunneled catheters); and daily review of the need for a central line, with prompt removal of unnecessary lines [16].

Mortality and Morbidity

The mortality data is useful when considering the cause of patient deaths from severe untreatable infection at the CVC site. When the guideline interventions fail, mortality data should be included in the outcomes measurement so that an account of how many deaths associated with severe infections has occurred. This is also true for morbidity. The CDC [1] keeps records of the morbidity of patients with central line infections and patients with this outcome need to be targeted for improved interventions.

Relevance to Own Practice

This guideline is pertinent to ICU practice for several reasons. Patient safety is a primary concern among providers and clinicians. Preventing injury such as infection caused by placing or caring for a CVC is necessary for patient safety. In addition to patient safety, best practice calls for following the guideline recommendations. In most ICUs, practitioners want to practice best evidence-based medicine or the latest guidelines recommended. Also, the guideline is measureable and can be used for performance improvement projects in the unit, especially for compliance in line care. There are many applications that can be made for the CVC guideline. For both clinicians and providers, the guideline represents a starting point of quality health care and patient satisfaction. Fig.(1) [17] shows the incidence per 1000 catheter days of bloodstream infections.

Health care infections are often expensive and a major source of morbidity and mortality. The Institute of Health bundle consists of five measures: hand hygiene; maximal barrier precautions; chlorhexidine skin antisepsis; optimal catheter site selection, with avoidance of the femoral vein for central venous access in adult patients; and daily review of the line necessity, with prompt removal of unnecessary lines [18]. This bundle is based on the National

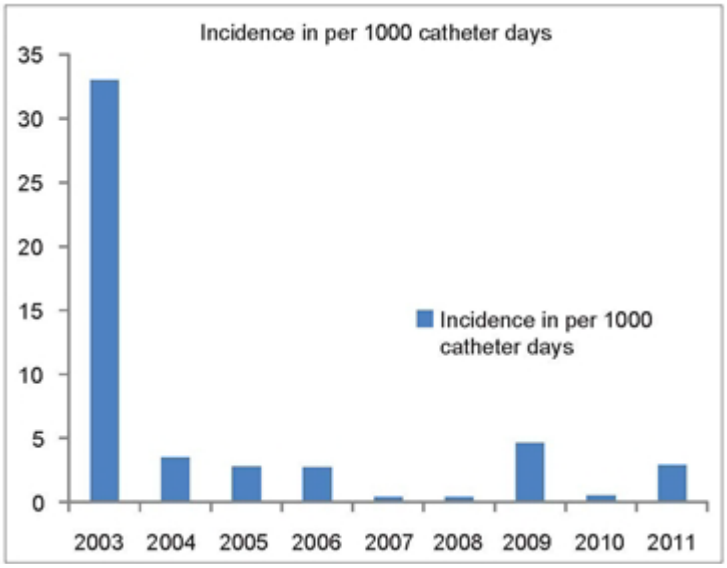

Fig.(1) Changing epidemiological trend of CRBSI

Clearinghouse Guideline [4]. This bundle is appropriately being implemented across the country. Currently 28 states have mandated the use of the bundle in preventing BSIs. Although over half the ICUs in the country now implement the bundle, sadly on 38% have shown full compliance [18]. While widely promoted, it is rarely implemented to its full extent, hindering the drop in BSIs.

In local ICUs, practitioners utilize the bundle based on the guideline to its full extent [6-8]. For all central lines, gowning, masking, and gloving, positioning of the line and antiseptic of choice is most important in preventing BSIs. The importance of preventing infection is key to patient safety and quality patient care. Following the National Guideline Clearinghouse Guideline [4] for CVC care will help nurses and practitioners provide better care for their patients through best practice proven through credible research. A need to adhere to strict guidelines when caring for patients with central lines has been proven by literature [16, 18]. The relevance to practice has been established by keeping key elements from the recommendations and forming them into a universal bundle by the Institute of Health for the prevention of BSIs.

Conclusions

In this paper, a number of ideas have been reviewed. The AGREE II tool has been used to evaluate the guideline for prevention of CVC infection from the National Guideline Clearinghouse [4]. The outcomes measurement tool used came from Mateo and Kirchhoff [15]. In the discussion it was pointed out that the guideline is strongly recommended for clinical practice and highly applicable to nursing and medicine. A firm background of supporting literature can validate the recommendations in the guideline. The guideline has proven relevant to clinical practice through its usefulness in assuring patient safety and decreasing morbidity and mortality rates associated with CVCs. In addition, the guideline is a blueprint for decreasing infection.

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Appendix A [19]

AGREE II Instrument

Domain 1. Scope and Purpose

1. The overall objective(s) of the guideline is (are) specifically described.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree**. The objective of the National Guideline Clearinghouse guideline [4] is well-written and concise. In a paragraph devoted to the intent and population, the purpose of the guideline and the expected benefits are outlined clearly. For example, the guideline covers all CVCs, including femoral, subclavian, internal jugular, peripheral, and peripherally inserted central catheters (PICCs). The length of time the catheter has been in contributes to the possibility of infection [4]. The first paragraph defines what might be called a blood stream infection (BSI) and how BSIs can be excluded by examination of the patient's record.

2. The health question(s) covered by the guideline is (are) specifically described.

1 Strongly disagree						7 Strongly agree

Comments **2. Moderately Disagree.** There is no clinical question. However, the clinical definitions of catheter-related infection are included in a separate paragraph in the opening section of the National Guideline Clearinghouse guideline [4]. The interventions necessary to prevent CVC infections are outlined in paragraph format in the guideline. The descriptions are clear and concise. The item content is easy to find. Every intervention is listed in paragraph format in detail. There is enough information to format a guideline for the practitioner.

3. The population (patients, public, etc.) to whom the guideline is meant to apply is.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** The population is specifically described in the guideline. Adult and pediatric patients with intravenous catheters are the target population and are clearly outlined in the guideline. The target population also includes those patients with intravascular, peripheral, and PICC lines [4]. The guideline can be used to apply to a variety of populations.

Domain 2. Stakeholder

4. The guideline development group includes individuals from all relevant professional groups.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** The National Guideline Clearinghouse guideline developers list is comprehensive. The list includes agencies such as the CDC, the Infectious Diseases Society of America, Infusion Nurses Society, Pediatric Infectious Diseases Society, Surgical Infection Society, American College for Chest Physicians, and more [4]. The comprehensive list of developers adds relevancy and credibility to the guideline as many professionals had input into putting the guideline into place.

5. The views and preferences of the target population (patients, public, etc.) have been sought.

1 Strongly disagree						7 Strongly agree

Comments **1. Strongly Disagree.** No views of the target population were sought during the development of the guideline. No studies were done to include the target population in the guideline [4]. There were no focus groups or interviews given.

6. The target users of the guideline are clearly defined.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** The target users are clearly defined by the guideline. Target users include anesthesia, critical care, infectious disease, internal medicine, nursing, pediatrics, pulmonary medicine, and others. The guideline has been written for anyone managing CVCs.

The target users are clearly laid out by specialty and are appropriate for this guideline [4].

7. Systematic methods were used to search for evidence.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** An electronic search was conducted on PubMed and Medline from 2000 to 2009 using the search terms catheter-related infections, prevention, catheterization, central venous/adverse effects, methods, standards, catheterization, peripheral/adverse effects catheterization, peripheral/methods catheterization, peripheral/standards, handwashing/standards. The number of source documents was not stated [4]. The search criteria appear comprehensive.

8. The criteria for selecting the evidence are clearly described.

1 Strongly disagree						7 Strongly agree

Comments **6. Moderately Agree.** Inclusion criteria were listed in this guideline however, exclusion criteria were not. Human studies in the English language was the only inclusion criteria listed [4].

9. The strengths and limitations of the body of evidence are clearly described.

1 Strongly disagree						7 Strongly agree

Comments **6. Moderately Agree.** The guideline based its recommendations mainly on meta-analyses and systematic reviews using randomized controlled studies and other quantitative studies. A few qualitative studies were used. There was no mention of study sampling limitations, allocation concealment, or blinding. All studies were appropriate for the outcomes to the guideline. There was a consistency of results across the studies, including the use of antiseptics for cleaning and handwashing techniques. There were also studies on the changing of dressings and the studies had similar outcomes . The magnitude of benefit is better than the

magnitude of harm for the studies included for the guideline. The studies are applicable to practice and should be considered suitable resources for use as evidence-based practice guidelines [4]. The recommendations were graded according to a rating scheme for strength of recommendation.

Domain 3. Rigour of Development

10. The methods for formulating the recommendations are clearly described.

1 Strongly disagree						7 Strongly agree

Comments **4. Agree.** Expert consensus was used to formulate the guideline. There was no mention of the Delphi process or any other method of how the developers reached the consensus [4]. It would have been more helpful to establishing validity to have expounded on the methods for formulating the recommendations.

11. The health benefits, side effects, and risks have been considered in formulating the recommendations.

1 Strongly disagree						7 Strongly agree

Comments **5. Moderately Agree.** The health benefits of the guideline include improved patient outcomes and decreased health care costs by reducing the infections associated with CVCs. Proper care and use can lead to safe and effective treatment using a CVC. The potential harms that were mentioned include allergic reactions, the emergence of multi-drug resistant organisms, toxicity, and other unforeseen complications such as these [4].

12. There is an explicit link between the recommendations and the supporting evidence

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** There is an explicit link between the recommendations and supporting evidence. Each recommendation has a literature reference linked to it. It is concise

and clearly easy to find. It is applicable and supports the data. This supporting literature adds weight to the recommendation, letting the practitioner know that the recommendation is not only supported by literature, but what literature it is supported by and where to find the supporting references.

13. The guideline has been externally reviewed by experts prior to its publication.

1 Strongly disagree						7 Strongly agree

Comments **1. Strongly Disagree.** There was no external review of experts prior to publication for the CVC guideline. According to the CDC [1], the group that developed the guideline was composed of a working group of society members from critical care, anesthesia, oncology, pulmonary medicine, and nursing. No other methods were undertaken to review the guideline.

14. A procedure for updating the guideline is provided.

1 Strongly disagree						7 Strongly agree

Comments **4. Agree.** The developers of the National Guideline Clearinghouse guideline for CVC use did map out a procedure for revision in the 2011 update of the guideline. This guideline is an update from the 2002 version of the existing guideline. A statement was made that this is an updated version and clearly and concisely communicated the new guideline's replacement over the old. New supporting literature was added to the old [4].

Domain 4. Clarity of Presentation

15. The recommendations are specific and unambiguous.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** The recommendations are clear and concise. Specific recommendations are targeted to either pediatric or adult patients. Each recommendation is

clearly written to the target population. There is no uncertainty in the recommendations.

16. The different options for management of the condition or health issue are clearly presented.

1 Strongly disagree						7 Strongly agree

Comments **5. Moderately Agree**. Because this is not a guideline based on the treatment of a disease, this section is hard to define for this guideline. The recommendations for the CVC guideline are directed toward preventing BSIs in adults and pediatric patients. There is no option for different treatments such as antibiotic suggestions.

17. Key recommendations are easily identifiable.

1 Strongly disagree						7 Strongly agree

Comments **7. Strongly Agree.** Key recommendations are grouped together in the CVC guideline (National Guideline Clearinghouse). For example, antimicrobial/antiseptic treatment is under one section while recommendation for use is under another section . The recommendations are easily read and understood. They are applicable to the problem and directly relate to the supporting literature. There is a chart with key recommendations listed and it is easily understood and applicable to the guideline and supporting literature. It outlines the types of catheters and entry sites and what steps need to be taken to prevent infection in each type catheter. Two more charts are available to the practitioner; one is for the type of unit and number of patients with catheters and number of infections and the other is the most common infections associated with CVCs. These charts are applicable to the outcomes of the guideline [4].

Domain 5. Applicability

18. The guideline describes facilitators and barriers to its application.

1 Strongly disagree						7 Strongly agree

Comments **2. Moderately Disagree.** There is no mention by developers of the CVC guideline about facilitators or barriers to application. There is a statement in the opening paragraph that reminds practitioners that this guideline is categorized based on scientific data, theoretical data, clinical applicability, and economic impact. The guideline was also developed using specific literature regarding CVC use and categorized by the developers. However, barriers to the application are not mentioned other than to note that adverse events such as toxicity, allergic reaction, and the development of multi-drug resistant organisms can be barriers to successful implementation of the guideline [4].

19. The guideline provides advice and/or tools on how the recommendations can be put into practice.

1 Strongly disagree						7 Strongly agree

Comments **1. Strongly Disagree.** The guideline states an implementation strategy was not provided [4]. No links, summaries, or pilot studies are available to immediately access. There is a citation at the end of each recommendation and the practitioner can directly go to the citation using the PubMed or Medline databases, however linking directly from the guideline is not possible.

20. The potential resource implications of applying the recommendations have been considered.

1 Strongly disagree						7 Strongly agree

Comments **4. Agree.** Guideline developers reviewed cost analyses however they did not elaborate on the process used or the results [4]. The cost of infection rates in CVCs in the United States was mentioned and the cost of preventing infections in the health care arena is presented. There are also more cost analyses on using the guideline [1].

21. The guideline presents monitoring and/or auditing criteria.

1 Strongly disagree						7 Strongly agree

Comments **4. Agree.** The guideline states that "evidence-based audit criteria will be developed based on this guideline". Each recommendation has evidence-based literature to support the recommendation. There are definitions on when dressing changes should be made, when catheters should be changed, how and where to place catheters in both adult and pediatric patients, and hygiene [4]. There is clear definition of the recommendations and supporting literature.

22. The views of the funding body have not influenced the content of the guideline.

1 Strongly disagree						7 Strongly agree

Comments **1. Strongly Disagree.** The source of funding for the CVC guideline is the U.S. Government. No mention is made as to whether the government influenced the guideline or not. The CDC guideline parallels the National Guideline Clearinghouse guideline and is interchangeable as the basis for the National Guideline Clearinghouse guideline is based on the CDC guideline [4].

23. Competing interests of guideline development group members have been recorded and addressed.

1 Strongly disagree						7 Strongly agree

Comments **1. Strongly Disagree.** There were no efforts made to minimize the risks of conflicts of interest. No mention was made of conflict of interest [4]. There are limitations in the guideline because it is important to note limitations.

Overall Guideline Assessment

1. Rate the Overall Quality of Guideline

1 Lowest possible quality						7 Highest possible quality

2. I would recommend this guideline for use.

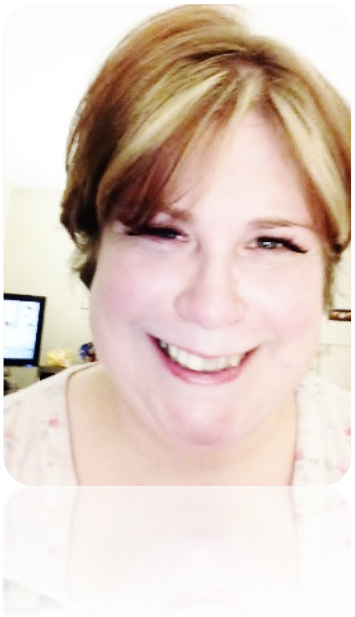
Yes	With Strongest Recommendation
Yes, with modifications	
No	

NOTES

Appendix B*: *Table of Recommendations

Category	Recommendation
Category IA	Strongly recommended for implementation & strongly supported by well-designed, experimental, clinical, or epidemiological studies
Category IB	Strongly recommended and supported by some experimental, clinical, and epidemiological studies, and a strong theoretical background, or an accepted practice (i.e. aseptic technique)
Category IC	Required by regulatory standards, federal or state
Category II	Suggested for implementation and supported by clinical and epidemiological studies and a theoretical background
Unresolved Issue	Represents an issue which evidence is insufficient or no consensus regarding efficacy can be reached

Authors Column



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