

Reducing Catheter Related Bloodstream Infections in Hemodialysis Patients

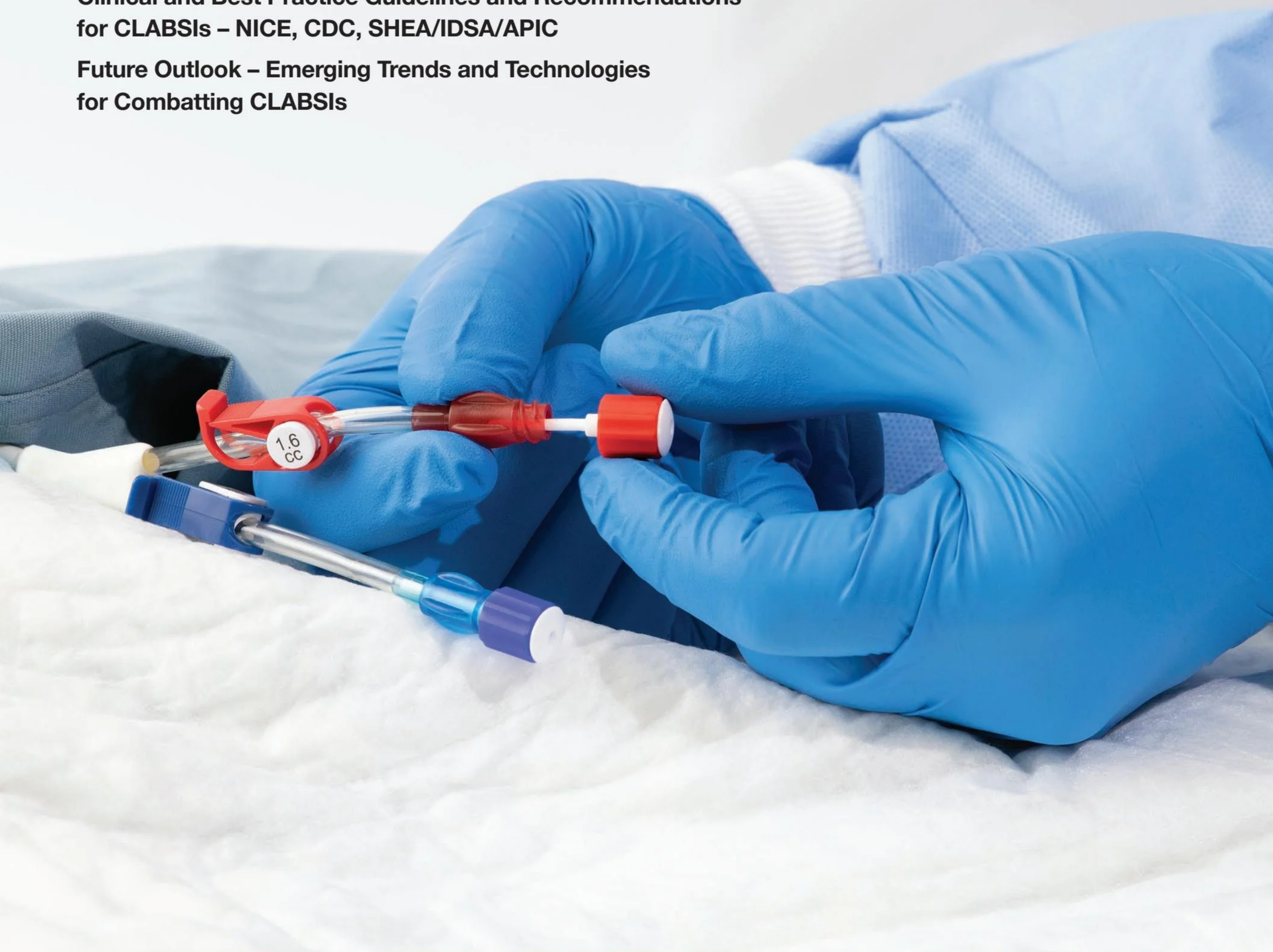
Knocking out Hemodialysis Catheter Infections with ClearGuard™ HD Caps

Current Significance of Catheter-Associated Bacteremia in Hemodialysis Patients. Can We Do More to Prevent It?

Economic Burden of CLABSIs – How Educational Initiatives to Reduce Bloodstream Infections Have Had Limited Impact

Clinical and Best Practice Guidelines and Recommendations for CLABSIs – NICE, CDC, SHEA/IDSA/APIC

Future Outlook – Emerging Trends and Technologies for Combatting CLABSIs





Clinically Proven to Reduce the Rate of CLABSI in Hemodialysis Patients^{1,2}

ClearGuard™ HD Antimicrobial Barrier Caps

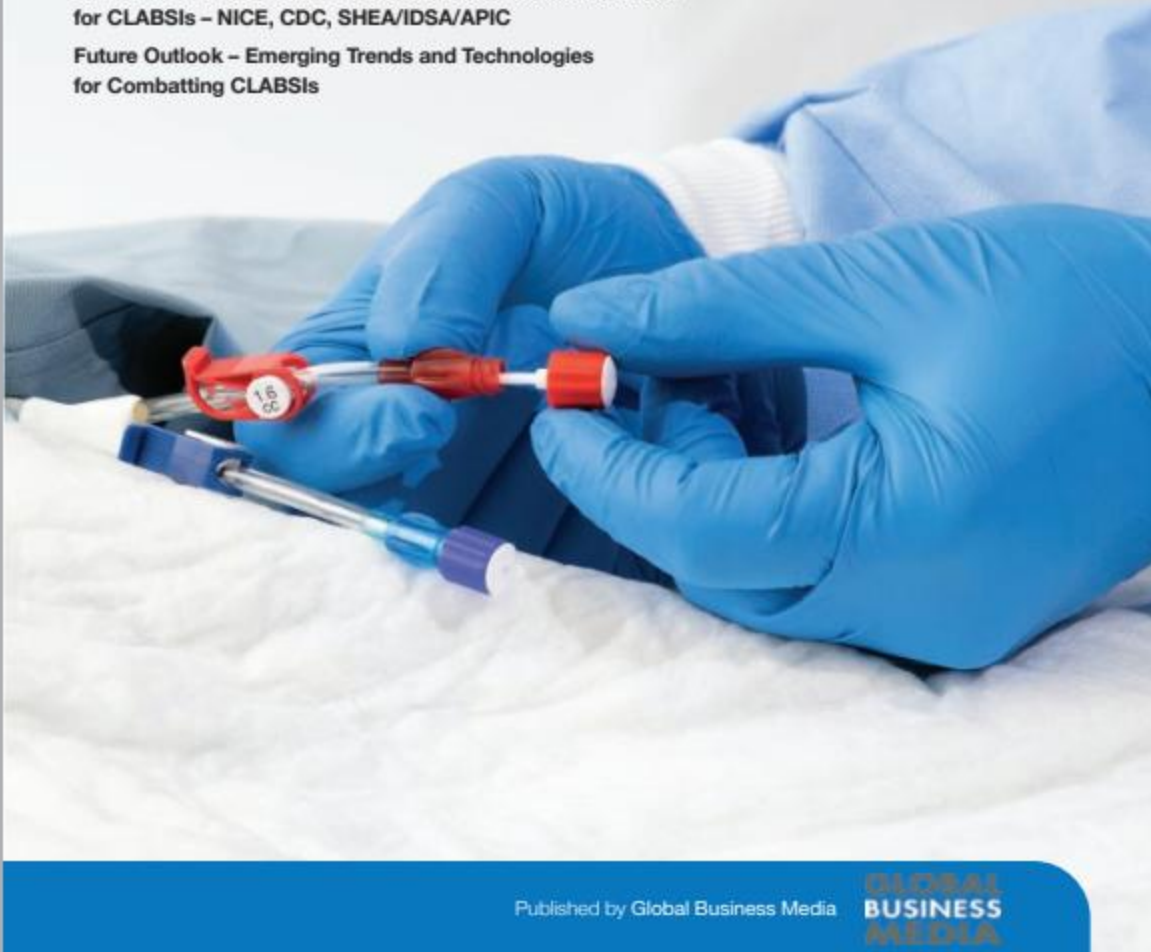
ClearGuard HD is the first and only device available to kill infection-causing bacteria inside a hemodialysis catheter hub. It is recommended by NFK's KDOQI Clinical Guideline for Vascular Access.³

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¹ Brunelli, SM et al. Cluster-randomized trial of devices to prevent catheter-related bloodstream infection. *J Am Soc Nephrol.* 2018 Apr;29(4):1336-1343.
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Foreword

In the landscape of healthcare, certain challenges persistently appear as significant obstacles to patient outcomes and system efficiency. Among these, Central Line-Associated Bloodstream Infections (CLABSIs) remain a prevalent concern, particularly in the Hemodialysis patient population. The collection of articles presented herein provides a thorough exploration of this issue, elucidating our understanding of the problem and shedding light on the promising strides we are making towards improved prevention, management, and eradication.

Our journey begins with the successful implementation of ICU Medical, Inc.'s ClearGuard™ HD antimicrobial barrier caps in a multi-hospital health system, a real-world testament to the power of innovative solutions in mitigating the risk of CLABSIs. However, the success story is juxtaposed by a stark reminder of the growing prevalence of Hemodialysis catheter infections, a major driver of hospitalisation and mortality in this vulnerable patient group. This underlines the dire need for diligent and robust prevention strategies in the face of this escalating issue.

Delving deeper, we scrutinise the heavy financial burden CLABSIs impose on our healthcare systems. Despite numerous educational initiatives designed to curtail this problem, the economic implications persist, prompting us to re-examine and rethink the current approach, demanding a more personalised, multifaceted strategy for better outcomes.

To this end, the guidance offered by prominent bodies such as NICE, CDC, SHEA/IDSA/APIC forms the bedrock of our clinical practice. These guidelines underscore the significance of personalised patient care, stringent infection control measures, and adherence to best practices in the management of central lines, setting the stage for the sustained reduction of CLABSIs.

Lastly, we gaze into the horizon of future trends and technologies poised to revolutionise the fight against CLABSIs. With the advent of innovations like ClearGuard HD antimicrobial barrier caps, we see a beacon of hope in this challenge-laden field. The blend of technology and innovative approaches could well signify a turning point in the battle against CLABSIs.

This collection serves as a comprehensive resource for healthcare professionals dedicated to combating CLABSIs. It prompts us to reflect on our current approach, while fuelling a shared aspiration for a safer, more efficient healthcare system that offers the highest quality of care to patients in need. We trust that this compilation will enlighten, inspire, and propel us toward a future where CLABSIs become a rarity rather than a commonality.

Dr. Jonathan D. Agnew
Editor

Jonathan D. Agnew PhD, MBA, is a medical writer and Adjunct Professor in the Faculty of Medicine at the University of British Columbia. He holds a PhD in health services research from the University of California, Berkeley, an MBA with distinction from the University of London, and an AB (hons.) in community health from Brown University.

Knocking out Hemodialysis Catheter Infections with ClearGuard™ HD Caps

Ashley Gordon, MSN, APRN, AGCNS-BC, CCRN, WakeMed Health & Hospitals

A large multi-hospital health system significantly reduced hemodialysis catheter infections by implementing ClearGuard HD antimicrobial barrier caps for all hemodialysis catheters present during admission at our organization.

Focusing on patient safety and reducing hospital-acquired infections is a top priority for healthcare organizations. Central line bloodstream infections (CLABSI) are one of the leading causes of mortality and increased costs to hospitals. According to the Agency for Healthcare Research and Quality (AHRQ), the average cost of one CLABSI is \$70,696¹. For this reason, reducing CLABSI is one of our strategic goals as an organization. Our mission is “Chasing Zero” for all hospital-acquired infections because we know these infections are preventable with the right tools and multidisciplinary collaboration. In our 970-bed health care system providing specialized care in trauma, pediatrics, heart & vascular, women’s health, neurology, orthopedics, and more, we continued to increase CLABSIs, specifically in our hemodialysis (HD) patient population. As a system, we strive to meet our CLABSI national benchmark goal and knew an action plan was indicated.

Hemodialysis patients are already at a higher risk for infection and other complications; however, those with a catheter have a 2-to-3-fold higher risk for infection than those with an arteriovenous fistula or graft². The Clinical Nurse Specialist (CNS) and infection prevention nurse tracked and reviewed each infection from the beginning of fiscal year 2021, leading to the observation that over 50% of our CLABSIs were HD catheters. From the 29 CLABSIs reviewed, 60% occurred after the catheter had been in place for an average of 10.5 days, ranging from 1 to 14 days. This data guided the CLABSI committee to refocus attention on newly inserted HD catheters. The organization’s standard of care for all other central and peripheral lines included utilizing a needleless connector in combination with an alcohol disinfectant cap; however, we did not have the same standardization for our HD catheters. Performing passive disinfection by applying a disinfectant cap is one of the practice recommendations in the Infusion Nurses Society standards of

practice³. Why did HD catheters have a different standard than all other central lines?

Implementation of ClearGuard HD caps

The CNS, infection prevention nurse, nephrology, critical care, and infectious disease providers all collaborated to review the literature and assess evidence-based practices within the organization. After reviewing our current practices and where the opportunities were, the committee decided to review different products on the market for use on HD catheters. The committee conducted a 90-day trial with the ClearGuard HD caps within the two larger hospitals in the system. Hemodialysis staff, critical care nurses, providers placing HD catheters, and procedural areas that care for or insert HD catheters received education and training. The ClearGuard HD caps were placed on every HD catheter within the two hospitals on the first day of the trial and any newly inserted lines after that. New ClearGuard HD caps were placed between HD and plex treatments or when a patient transitioned from continuous renal replacement therapy (CRRT) to intermittent HD. The caps were also placed on all HD lines on admission if a patient presented with one in place.

The committee decided on ClearGuard HD caps for two main reasons: ease of implementation and the mode of action in reducing infections



ClearGuard™ HD Antimicrobial Barrier Caps are used in place of a standard cap or connector. When the ClearGuard HD cap is inserted into a liquid-filled catheter, chlorhexidine elutes from the rod into the catheter lock solution. The chlorhexidine coating dissolves to kill microorganisms on the inside and outside of the catheter hub. The existing catheter clamp holds the antimicrobial agent inside the catheter hub between treatments.

After nine months of utilizing ClearGuard HD, including the trial period, the organization has only had one CLABSI with an HD catheter resulting in a 93% reduction in HD CLABSI infections

Why ClearGuard HD?

The committee decided on ClearGuard HD caps for two main reasons: ease of implementation and the mode of action in reducing infections. (1) Ease of implementation - Since these caps did not warrant a procedure change and were used the same way as a standard end cap, the education and implementation were much more manageable. The organization replaced one product with another, but the process of placing and removing was the same, which increased the likelihood of success and compliance. (2) The mode of action - Infections begin through two types of entry, extraluminal and intraluminal. Extraluminal infections occur from pathogens migrating along the external surface of the catheter to the insertion site, which often presents within seven days of insertion⁴. In contrast, an intraluminal infection originates at the catheter hub and can migrate internally through the catheter lumens, most commonly occurring after seven days⁴.

Intraluminal-based infections usually stem from gaps in care and line maintenance. The organization's average time of catheter duration at the time of infection and awareness of the frequency of dialysis catheter access led to a focus on intraluminal infection reduction strategies.

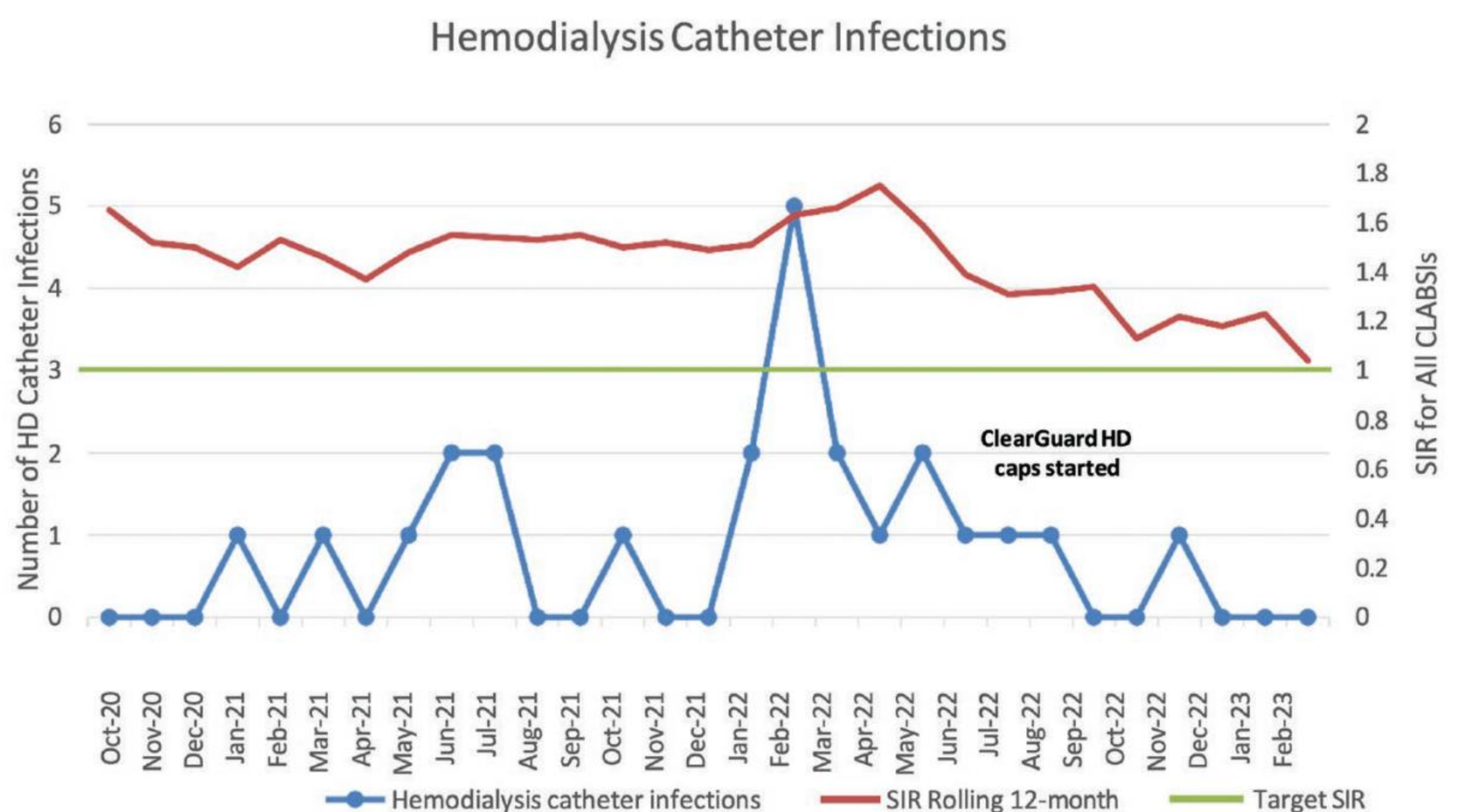
ClearGuard HD caps' mode of action supports intraluminal infection reduction. Organisms can be transferred into the catheter during the access or deaccess of the line and flushed into the bloodstream. In between the use of the catheter, these organisms can sit in the catheter space within the hub and clamp, creating a biofilm⁴. The ClearGuard HD cap has a chlorhexidine - coated rod that sits in this space between the hub and clamp, killing organisms that may have eventually traveled down the catheter into the bloodstream

resulting in a bloodstream infection⁴. The goal for implementing ClearGuard HD was to avoid infections that we know were preventable; however, not all infections can be prevented if a catheter has been in place for a very long duration and has already been colonized or poorly cared for outside of the organization.

Impact on Quality Outcomes

During the 90-day trial, August 8- November 7, 2022, we had zero CLABSIs related to HD lines. Graph 1 shows a CLABSI documented in August; however, this infection was in a patient who had the catheter for over a year and was previously colonized. To be consistent with prior ClearGuard HD studies, to avoid counting pre-existing BSIs, patients were censored for the first 21 days⁴. Due to the trial's success, the organization approved for complete purchase of the product. The CNS collaborated with key stakeholders in fully transitioning the organization to have ClearGuard HD stocked in all HD units, intensive care units, and interventional radiology departments by December 2022. The organization prioritizes monitoring and compliance with any new product implementation to ensure sustainability. The CNS conducted daily audits of HD catheters during the trial and then transitioned to weekly for the first three months of implementation and now every month. The intensive care and acute care units integrated this audit into daily safety huddles, allowing real-time observation of the caps being in place and an opportunity to assess any issues with supplies or processes. Observed compliance with using ClearGuard HD caps remained at 98% after implementation into the system and is now a part of the central line maintenance bundle for HD catheters.

After nine months of utilizing ClearGuard HD, including the trial period, the organization has



Graph 1: Decreased infections and SIR after implementation of ClearGuard HD caps.

only had one CLABSI with an HD catheter resulting in a 93% reduction in HD CLABSI infections. Refer to Table 1. Per the National Healthcare Safety Network (NHSN), the Standardized Infection Ratio (SIR) is the primary summary measure to track healthcare-acquired infections⁵. It allows for a comparison to the national benchmark. The SIR is presented as a rolling 12-month ratio with a target of less than 1.0, meaning fewer CLABSIs were observed as predicted. The organization's SIR has maintained an average of 1.5 for over two years until October 2022 (see Graph 1). This SIR includes all central line infections, not just hemodialysis; however, the data shows substantial improvement after implementing ClearGuard HD caps since the majority of previous infections were related to HD lines.

Conclusion

By reducing these infections, the organization not only experienced a return on investment but also saved patients from harm. Hemodialysis

catheters are a patient's lifeline to treatment, and if they become infected, there is an increased risk for catheter removal, antibiotic therapy, increased hospital stay, and even death. Utilizing an antimicrobial cap such as ClearGuard HD can effectively reduce the number of CLABSIs in HD catheter patients. Over the past two years, our organization has provided education and utilized a central line care and maintenance bundle. However, implementing the antimicrobial barrier cap for HD lines has been one of the most successful interventions for the complex HD patient population. It is essential to have multidisciplinary key stakeholders and executive leadership support when implementing change in a health system. To sustain success, it is necessary to have dedicated personnel and resources to identify gaps and facilitate timely interventions to reduce infections and improve patient outcomes.

ClearGuard™ HD is a trademark of ICU Medical, Inc.

However, implementing the antimicrobial barrier cap for HD lines has been one of the most successful interventions for the complex HD patient population

Table 1:

Pre ClearGuard HD	(Nov. 2021 – Jul. 2022)	15 CLABSI episodes
Post ClearGuard HD	(Aug. 2022 – Apr. 2023)	1 CLABSI episode

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Ashley Gordon graduated with a BSN at East Carolina University in 2012 and, in May of 2018, graduated with an MSN with a Clinical Nurse Specialist focus in adult-gerontology from East Carolina University. The North Carolina Board of Nursing recognizes her as an advanced practice registered nurse (APRN), is CNS-certified by the ANCC, and holds a certification in critical care nursing (CCRN). Ashley is involved in several professional organizations such as AACN, ANCC, SCCM, and NACNS and has presented locally and nationally on different topics within critical care.

Current Significance of Catheter-Associated Bacteremia in Hemodialysis Patients. Can We Do More to Prevent It?

Luis Gil Sacaluga. UGC Uronephrology, Hospital Virgen del Rocío, Seville, Spain.

The catheter was considered as the patient's definitive vascular access in up to 72% of cases

Abstract: The number of hemodialysis patients using catheters is increasing, leading to an increased risk of developing central line-associated bloodstream infections (CLABSI), with serious and devastating consequences. As nephrologists, it is our duty to attempt to reduce the number of catheters in our units as much as possible, and to implement all possible measures aimed at preventing these infections.

Introduction

All Clinical Guidelines agree that the vascular access of choice for hemodialysis patients is the native or prosthetic internal arteriovenous fistula,^{1,2} given that catheters are associated with a greater number of complications -mainly thrombotic and infectious-, and lower survival of both the vascular access and the patients themselves.

Unfortunately, the progressive increase in the age and comorbidity of patients on hemodialysis means that the presence of catheters in our units is rising.³

For example, up to 60.7% of the 1020 patients who initiated hemodialysis in the Autonomous Community of Andalusia in 2021 did so through

a catheter (5.1% more than 10 years ago), and 41% of the 4593 prevalent patients on hemodialysis that same year used a catheter as vascular access (9% more than 10 years ago)⁴ (see Figure 1).

But the most serious aspect is that, according to a survey we conducted in our hemodialysis sites in 2018, the catheter was considered as the patient's definitive vascular access in up to 72% of cases (*unpublished personal data*). The main reasons for this were the impossibility of performing an internal vascular access (44% of cases), contraindication to its insertion (e.g., due to severe pulmonary hypertension or heart disease) (21% of cases) or based on the patient's desire despite our recommendations (18% of cases).

Hemodialysis Catheter-Related Bacteremia

As previously indicated, hemodialysis catheter-related complications include infectious complications, like the development of associated bacteremias, most of which are caused by gram-positive flora colonizing the skin around the catheter insertion site.⁵



Figure 1. Evolution of prevalent vascular access use in Andalusia 2012-2021

After analyzing 120 tunneled catheter-related bacteremias that occurred among our patients between 2013 and 2018, we found that 30% of the cases were caused by *S. aureus*, and 32.5% by other gram-positive microorganisms (*unpublished personal data*).

The literature describes a frequency of catheter-related bacteremia ranging from 0.4 to 6 episodes per 1000 catheter-days, which is consistent with an incidence of 0.15-2 episodes per catheter-years,^{6,7} these episodes being 2-3 times more common among patients using non-tunneled catheters, compared to those using tunneled catheters.⁸



ClearGuard™ HD Antimicrobial Barrier Caps, ICU Medical

Despite our efforts, over the course of the last 10 years in our Department, catheter-related bacteremia has been responsible for an average of 4.1% (95% CI 3.2-4.9%) of admissions of our patients on hemodialysis (*unpublished data*). This is especially relevant if we consider that it is a serious process that usually leads to catheter removal and, sometimes, the development of distant septic complications, and even death.⁹

Lastly, it is important to note that, when we manage these infectious processes, we increase the likelihood of inducing bacterial resistance, which will make their care increasingly difficult, worsen the prognosis and exhaust all therapeutic options. It is vital to apply the correct approach, performing catheter removal without delay when so indicated¹⁰ and managing antibiotics as wisely as possible.¹¹

Preventing Hemodialysis Catheter-Related Bacteremia

It is clear that we need to continue working to reduce the percentage of catheters in our Units as much as possible. However, these devices are - and will continue to be - essential for patient survival, and we must implement measures aimed at preventing the development of catheter-related bacteremias.¹²⁻¹⁵

Therefore, catheters should be reserved solely and exclusively for hemodialysis and handled by qualified staff. Also, each Hemodialysis Unit must have a protocol thoroughly describing the use of an aseptic technique for catheter placement and subsequent management (*see Figure 2*).



Figure 2. Disinfection of the connector with chlorhexidine: a simple step that saves lives

Unit staff must be trained on the importance of routine hand hygiene before and after contact with the patient, and before and after putting on gloves, in order to avoid cross-infection.

Chlorhexidine disinfection should be considered an essential practice in our Units, being especially indicated in patients on hemodialysis because it requires less application and drying time than other products, and it does not affect catheter materials. Thus, the recommendation is to wash the patient with a chlorhexidine soap solution,¹⁶ the use of alcoholic chlorhexidine solutions for skin disinfection prior to catheter placement,¹⁷ as well as the use of aqueous-based chlorhexidine for catheter disinfection (including areas of connectors located under the caps).¹⁸ The use of dressings with chlorhexidine-impregnated sponges¹⁹ has also proven its prophylactic efficacy. However, it is worth acknowledging that the widespread use of chlorhexidine may lead to reduced sensitivity²⁰ of difficult detection and unknown clinical impact.

In contrast, the routine use of prophylactic antibiotic therapy - such as the application of intranasal antimicrobials to eradicate *S. aureus* carrier state,²¹ the administration of systemic antibiotic therapy prior to catheter placement²² or the antibiotic lock²³ - is discouraged; despite its potential effectiveness, it can be associated with infections by multidrug-resistant microorganisms, allergies and toxicities¹.

A number of additional measures have been reported, which have also proven to be effective in reducing catheter-related bacteremia without inducing antibiotic resistance and could be useful in Units with high rates of infection despite standard precautions. Some examples are locking the catheter with antiseptics (such

It is important to note that, when we manage these infectious processes, we increase the likelihood of inducing bacterial resistance, which will make their care increasingly difficult, worsen the prognosis and exhaust all therapeutic options

as taurolidine, ethanol or methylene blue/ parabens²⁴⁻²⁶) or the use of bioconnectors²⁷ and chlorhexidine-impregnated caps.^{28,29}

Conclusion

Unfortunately, the percentage of hemodialysis patients with catheters is rising, as is the risk of related bacteremia. Implementing all possible measures aimed at preventing this complication is key.

Prevention must be based on proper catheter management by qualified staff, following the Clinical Practice Guideline recommendations and avoiding the use of prophylactic antibiotics whenever possible, due to the risk of inducing infections by multi-resistant microorganisms.

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Biography:

Dr. Luis Gil Sacaluga is a nephrologist trained at Hospital Virgen del Rocío in Seville (Spain) between 1989 and 1992.

He has worked mainly in the patient care sector, starting up a peripheral hemodialysis site and working there for seven years, and then returning to Hospital Virgen del Rocío in 2000, where he is currently working at the Hospital Hemodialysis Unit. He has been a member of the Control and Monitoring Committee of the Hemodialysis Module of the Chronic Renal Insufficiency Subsystem of the Andalusian Autonomous Transplant Coordination Information System (SICATA) since 2006.

He also collaborated in the development of the book titled "Comprehensive Patient Care Process. Renal Replacement Therapy for Advanced Chronic Kidney Disease: Dialysis and Kidney Transplantation" ["Proceso Asistencial Integrado (PAI): Tratamiento sustitutivo de la enfermedad renal crónica avanzada: diálisis y trasplante renal"] published in 2015, as well as the protocol titled "Prevention and Management of Catheter-Related Infections in Patients Enrolled in the Hemodialysis Program" ["Prevención y manejo de las infecciones relacionadas con el Catéter en pacientes en programa de hemodiálisis"] at his current hospital, published in 2023 on the website of the Institutional Program for the Optimization of Antimicrobial Treatment (Programa Institucional para la Optimización del Tratamiento Antimicrobiano, PRIOAM).

Hemodialysis catheter-related complications include infectious complications, like the development of associated bacteremias, most of which are caused by gram-positive flora colonizing the skin around the catheter insertion site

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Economic Burden of CLABSIs – How Educational Initiatives to Reduce Bloodstream Infections Have Had Limited Impact

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Central Line-Associated Blood Stream Infections (CLABSIs) persist in placing a considerable economic burden on healthcare systems, despite the implementation of numerous educational initiatives designed for their prevention. This article critically examines the apparent limited impact of these initiatives and probes into the potential reasons for their shortfall. It also proposes potential enhancements and future directions, highlighting the necessity for a more comprehensive and tailored approach to effectively address this urgent issue.

Despite concerted efforts to tackle this issue, the prevalence and burden of CLABSIs remain high, underscoring the need for more effective intervention strategies

Introduction

Central Line-Associated Blood Stream Infections (CLABSIs) represent a severe yet preventable threat to patient safety in the healthcare system.¹ With substantial implications for patient morbidity, mortality, and increased healthcare costs, CLABSIs signify a substantial economic burden.²⁻⁴ Over the past decades, various educational initiatives have been instituted to prevent these infections, aiming to promote best practices among healthcare professionals and foster an environment of patient safety.⁵⁻⁷ However, despite these commendable efforts, the impact of these initiatives appears to be less profound than anticipated. This article seeks to elucidate the economic ramifications of CLABSIs and critically assess the effectiveness of current educational strategies in mitigating this critical issue.

CLABSIs are a widespread and persistent issue in healthcare settings, both globally and domestically. A study by the Centers for Disease Control and Prevention (CDC) indicates that in the United States alone, approximately 43,000 CLABSIs occur in intensive care units and wards each year.²

Scope of the Problem

The economic burden of these infections is significant. The mean hospital cost per episode of CLABSI is estimated to be over \$36,000 per infection in the United States, accounting for increased lengths of hospital stay, additional laboratory and diagnostic tests, and the need for further treatment and interventions.⁸ When these individual costs are extrapolated to a population level, it equates to an economic burden of over \$1.5 billion annually in the U.S.⁹

Moreover, the toll extends beyond financial considerations. CLABSIs are associated with a considerable increase in patient morbidity and mortality.^{2,4} Patients with CLABSIs are likely to experience extended hospital stays and have a higher risk of complications. In fact, CLABSI-associated mortality rates range from 12% to 15%, highlighting the grave clinical burden of these infections.¹⁰

Given these alarming statistics, it is clear that the current level of CLABSIs represents a substantial public health problem. Despite concerted efforts to tackle this issue, the prevalence and burden of CLABSIs remain high, underscoring the need for more effective intervention strategies.

Current Educational Initiatives

In an attempt to curb the occurrence of CLABSIs, numerous educational initiatives have been rolled out in healthcare settings. These initiatives predominantly focus on providing healthcare professionals with knowledge and skills to prevent the occurrence of CLABSIs.

One widely adopted initiative is the Central Line Bundle, a strategy endorsed by the Institute for Healthcare Improvement (IHI).¹¹ This bundle comprises a series of evidence-based practices, such as hand hygiene, use of full-barrier precautions during the insertion of central lines, and proper site selection. The goal is to reduce the risk of infection during central line insertion and maintenance.

The Comprehensive Unit-based Safety Programme (CUSP), another prominent initiative, integrates safety culture, teamwork, and communication in addition to technical components to reduce CLABSI rates.¹² CUSP

teams typically include a senior executive, a physician, a nurse leader, and frontline staff, creating an interdisciplinary approach to tackling the problem.

Furthermore, programmes such as “Target Zero” involve consistent monitoring and feedback, along with the use of a checklist to ensure adherence to best practice guidelines during line insertion and maintenance.¹³

While these initiatives are theoretically sound and evidence-based, their real-world impact appears to be limited, indicating a gap between theory and practice. Some notable examples of dramatic decreases in CLABSI rates have been observed, but overall rates remain significant, and concerningly rates increased during the COVID-19 pandemic.^{14,15}

Limitations of Current Educational Initiatives

While the educational initiatives currently in place are well-intentioned and theoretically sound, they have fallen short in significantly reducing or eliminating CLABSI rates. There are several potential reasons for this limited effectiveness.

First, the inconsistency in the implementation of these initiatives is a major barrier. Healthcare professionals may not uniformly apply the recommended practices due to a lack of awareness, insufficient time, or inadequate resources. Such inconsistencies can undermine the potential effectiveness of these initiatives.

Second, the ‘one-size-fits-all’ approach may not work across all healthcare settings. Different units may have unique challenges and constraints that need tailored strategies rather than a uniform approach. A lack of customisation could be contributing to the limited impact of these initiatives.

Third, while these initiatives focus on improving technical skills, there may be insufficient emphasis on fostering a safety culture. The effectiveness of these programmes often depends on the commitment and engagement of both management and frontline staff, which may be lacking in some institutions.

Fourth, another limitation of current educational initiatives could be the failure to adopt or promote the use of proven technology to aid in the reduction of CLABSI. A prime example can be drawn from a multi-hospital health system that achieved significant reductions in hemodialysis catheter infections.

This success was largely attributed to their strategic implementation of ICU Medical, Inc.’s ClearGuard™ HD antimicrobial barrier caps for all hemodialysis catheters present during admission. The use of such antimicrobial technology can provide an additional layer of

protection against infections and supplement the effect of proper hygiene and handling practices taught in the educational initiatives.

Lastly, there may be a lack of continuous monitoring and feedback mechanisms to keep track of progress and make necessary adjustments. Without this feedback, it is challenging to identify areas of improvement and monitor the success of the initiative.

Thus, while current educational initiatives are a step in the right direction, they may need significant refinement and reinforcement to achieve their potential.

Potential Improvements and Future Directions

To enhance the effectiveness of educational initiatives, a more tailored and comprehensive approach may be necessary. First, it is essential to consider the unique challenges of each healthcare setting.

Customising strategies to fit specific circumstances could enhance adherence to best practices and, consequently, reduce CLABSI rates.

Moreover, fostering a safety culture within healthcare institutions is vital. This involves cultivating an environment that encourages reporting of errors, interdisciplinary communication, and continuous learning. Strong leadership commitment is crucial in this endeavour, as it sets the tone for the entire organisation.

Integrating technology could also be beneficial. Digital monitoring systems and simulation-based training could improve adherence to guidelines and enhance healthcare professionals’ skillsets.

Finally, more robust and continuous monitoring mechanisms are required. Real-time feedback allows for immediate corrective action and provides an opportunity for ongoing learning and improvement.

Given the considerable economic and humanistic burden of CLABSIs, investing in these enhancements and exploring novel strategies is crucial for improving patient safety and reducing healthcare costs.

Conclusion

The economic and health burden of CLABSIs remains a pressing issue despite existing educational initiatives. While these strategies have value, their impact is limited due to various implementation and cultural barriers. Enhancing customisation, fostering a safety culture, integrating technology, and strengthening monitoring systems are promising ways to bolster their effectiveness. Addressing this issue is crucial for improving patient outcomes and reducing healthcare costs.

Some notable examples of dramatic decreases in CLABSI rates have been observed, but overall rates remain significant, and concerningly rates increased during the COVID-19 pandemic

ClearGuard™ HD is a trademark of ICU Medical, Inc.

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*Fostering a safety culture
within healthcare institutions is vital*

Clinical and Best Practice Guidelines and Recommendations for CLABSIs—NICE, CDC, SHEA/IDSA/APIC

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Central Line-Associated Bloodstream Infections (CLABSIs) are hospital-acquired infections that present substantial health risks, often resulting in prolonged hospital stays, increased morbidity, and escalated healthcare costs. Guidelines and best practice recommendations issued by various bodies underscore the critical need for stringent infection control measures, personalised patient care, and adherence to best practices in the management of central lines. These guidelines target all patient populations, especially those at high risk for CLABSIs, highlighting the importance of comprehensive and proactive strategies to prevent and manage these infections.

Introduction

CLABSIs are severe hospital-acquired infections that pose significant threats to patient health outcomes and escalate healthcare costs. These infections occur when bacteria or other microbes enter the bloodstream through a central line, a common type of intravascular catheter. Due to the serious complications associated with CLABSIs, including prolonged hospital stays, increased morbidity, mortality, and substantial financial implications, there has been a concerted effort to emphasise the prevention and management of CLABSIs in the global landscape of healthcare quality improvement. This article examines the guidelines and best practice recommendations outlined by three key health organisations: The National Institute for Health and Care Excellence (NICE), the Centers for Disease Control and Prevention (CDC), and the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America/Association for Professionals in Infection Control and Epidemiology (SHEA/IDSA/APIC). These guidelines provide detailed and practical strategies for healthcare professionals to prevent, diagnose, and manage CLABSIs. The focus is on enforcing rigorous infection control protocols, adhering to the best practices in catheter care, and delivering individualised patient care to minimise the risk and impact of these infections.

Understanding CLABSIs

CLABSIs are complex, hospital-acquired infections that pose significant threats to patient health, particularly in intensive care units and

among those receiving long-term intravenous therapies. Risk factors for CLABSIs encompass a broad range, including extended duration of catheterisation, inappropriate insertion techniques, poor maintenance practices, and the underlying health status of the patient. The most common pathogens implicated in CLABSIs include coagulase-negative staphylococci, *Staphylococcus aureus*, enterococci, and *Candida* species. However, the specific microorganisms involved can vary depending on multiple factors such as the patient population, geographic location, and individual hospital practices.

CLABSIs can lead to severe complications such as sepsis, endocarditis, and other metastatic infections. Moreover, they can lengthen hospital stays, increase treatment costs, and elevate mortality rates, thereby underlining the importance of robust preventative measures. Despite advancements in clinical practices, CLABSIs remain a prevalent issue in healthcare settings, necessitating strict adherence to guidelines and recommendations aimed at reducing their incidence.

NICE Guidelines and Recommendations for CLABSIs

The National Institute for Health and Care Excellence (NICE) has revised its guidelines for Hemodialysis catheter-related bloodstream infections.¹ Alongside established recommendations - such as using a standardised, sterile technique during catheter insertion and ensuring consistent catheter maintenance - the NICE has incorporated a new recommendation concerning the use of ICU

CLABSIs can lead to severe complications such as sepsis, endocarditis, and other metastatic infections

Due to the uncertainty around the long-term effects of chlorhexidine exposure, NICE has called for the collection of data in this area, especially in paediatric populations

Medical, Inc.'s ClearGuard™ HD antimicrobial barrier caps.

The ClearGuard HD caps, used with central venous catheters in Hemodialysis, contain a rod coated in the antimicrobial chlorhexidine acetate to reduce infection. Clinical evidence suggests these caps significantly reduce the risk of CLABSIs when compared with other options. Moreover, cost modelling indicates their use could result in substantial savings for the NHS due to the decreased incidence and associated treatment cost of CLABSIs.

While evidence in children is limited, ClearGuard HD caps are anticipated to offer a similar reduction in CLABSI risk. However, due to the uncertainty around the long-term effects of chlorhexidine exposure, NICE has called for the collection of data in this area, especially in paediatric populations.

This recommendation emphasises the value of integrating novel technologies into clinical practice and underlines the need for ongoing monitoring of their long-term effects.

Review of the CDC Guidelines for CLABSIs

The Centers for Disease Control and Prevention (CDC) plays a crucial role in developing evidence-based guidelines to reduce the incidence of CLABSIs.² Their recommendations encompass a broad range of strategies, from prevention to management, to ensure optimum patient safety and care.

Prevention Strategies as Outlined by the CDC

- **Education and Training:** The CDC emphasises the need for rigorous training of healthcare personnel in infection prevention. They stress on the importance of understanding the correct procedures for catheter insertion, maintenance, and timely removal to prevent potential complications.
- **Maximal Sterile Barrier Precautions:** These precautions involve the use of long-sleeved sterile gowns, sterile gloves, surgical masks, and large sterile drapes during central line insertion. These measures aim to minimise the contamination of the catheter at the time of insertion, thus reducing the risk of infection.
- **Chlorhexidine Skin Antisepsis:** The CDC recommends the use of chlorhexidine as the preferred antiseptic for skin preparation before central line insertion and during dressing changes. Studies have shown chlorhexidine to be more effective than other antiseptics in reducing skin flora and preventing CLABSIs.

Management and Treatment Options per the CDC Guidelines

If a CLABSI does occur, the CDC provides guidelines for management and treatment. These include the removal and culture of the central line if possible, blood cultures from the patient, and appropriate antibiotic therapy based on the organism isolated.

Analysis of the SHEA/IDSA/APIC Guidelines for CLABSIs

The Society for Healthcare Epidemiology of America/Infectious Diseases Society of America/Association for Professionals in Infection Control and Epidemiology (SHEA/IDSA/APIC) guidelines provide another essential resource for preventing and managing CLABSIs.³

Prevention Recommendations by SHEA/IDSA/APIC

- **Hand Hygiene and Skin Antisepsis:** SHEA/IDSA/APIC guidelines strongly emphasise hand hygiene as a primary prevention strategy. Use of alcohol-based hand rub or soap and water before and after contact with the patient or the central line is recommended. Similar to the CDC guidelines, they advocate for the use of chlorhexidine for skin antisepsis before central line insertion and during dressing changes.
- **Proper Catheter Insertion and Maintenance:** SHEA/IDSA/APIC guidelines recommend a careful and sterile procedure during catheter insertion. Maximal sterile barrier precautions, similar to the CDC's recommendation, are advised. They also underscore the importance of routine inspection and maintenance of the central line and prompt removal when it's no longer necessary.

When a CLABSI does occur, SHEA/IDSA/APIC suggests management strategies including proper assessment, timely blood cultures, antibiotic treatment based on the isolated organism, and removal of the infected central line when feasible.

The SHEA/IDSA/APIC guidelines draw strength from their combined expertise and focus on practical implementation. They represent a comprehensive approach to preventing, managing, and treating CLABSIs that is backed by a robust evidence base. However, similar to the CDC guidelines, one limitation is the potential challenge of implementation in settings with limited resources. Also, these guidelines may need to be contextualised to cater to specific regional or institutional needs and constraints.

Conclusion

A comparative analysis of the guidelines issued by the National Institute for Health and Care Excellence (NICE), the Centers for Disease Control and Prevention (CDC), and the Society for Healthcare Epidemiology of America/ Infectious Diseases Society of America/ Association for Professionals in Infection Control and Epidemiology (SHEA/IDSA/APIC) reveals significant overlap, with each providing a unique emphasis that can complement the others.

All three sets of guidelines agree on some fundamental prevention strategies. Hand hygiene, aseptic technique during insertion, chlorhexidine skin antiseptics, and proper maintenance and timely removal of central lines form the backbone of all three guidelines. Education and training of healthcare personnel also find a common place in all guidelines, emphasising the importance of this aspect in preventing CLABSIs.

Despite these similarities, the guidelines also present some differences. NICE places

greater emphasis on the choice of central venous access devices and their care, offering more specific recommendations in this regard. The CDC, on the other hand, provides more detailed recommendations on maximal sterile barrier precautions during central line insertion. Meanwhile, SHEA/IDSA/APIC focuses more on practical application, making their guidelines more accessible for healthcare providers.

These guidelines, while offering a similar approach to CLABSIs prevention, each provide a unique perspective that can supplement each other. The detailed nature of the NICE guidelines complements the practical approach of SHEA/IDSA/APIC, while the CDC provides a broad, robust set of guidelines that can serve as a foundation. By integrating these guidelines, healthcare providers can develop a comprehensive and tailored approach to prevent, manage, and treat CLABSIs in their institutions.

ClearGuard™ HD is a trademark of ICU Medical, Inc.

The SHEA/IDSA/APIC guidelines draw strength from their combined expertise and focus on practical implementation

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Future Outlook – Emerging Trends and Technologies for Combatting CLABSIs

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Efforts to reduce central line-associated bloodstream infections (CLABSI) have led to several advances, including the emerging ICU Medical, Inc. ClearGuard™ HD antimicrobial barrier caps. Diving into the specifics of these innovations, this article examines their efficacy and potential implications in reducing CLABSI occurrence. The promising future of CLABSI reduction strategies, which may include a blend of technology and innovative approaches aimed at improving patient outcomes and efficiency, offers reason for optimism in tackling this challenging problem in healthcare.

At the crux of these advancements is the recognition that human error, in the form of inadequate sterilisation or incorrect handling, plays a significant role in the incidence of these infections

Introduction and Understanding of CLABSI

CLABSI represent a significant clinical concern in healthcare facilities globally. They occur when bacteria or other pathogens enter the bloodstream through a central line - a widely used vascular access device for patient treatment. In the United States alone, there are an estimated 43,000 cases of CLABSI each year, underscoring the severity and scale of the issue.¹

A CLABSI can develop when the central line is not adequately maintained or handled, often during insertion or due to contamination at the catheter hub. The ensuing infection can lead to severe patient complications, including sepsis and endocarditis, significantly prolonging hospital stays and increasing medical costs.²

Currently, CLABSI prevention practices primarily encompass stringent infection control measures such as hand hygiene, use of full-barrier precautions during central line insertion, and disinfection of the catheter hub before accessing the line. However, these conventional practices have their limitations, including reliance on strict adherence and the potential for human error.

The medical field is continually advancing, and in the ongoing quest to improve patient outcomes, emerging trends and technologies designed to mitigate the risk of CLABSI present promising options. This article provides an in-depth look at these innovations, focusing particularly on ClearGuard HD antimicrobial barrier caps and comparing them with other emergent technologies in the field.

Emerging Trends in CLABSI Reduction

In the fight against CLABSI, the healthcare field is progressively pivoting towards a blend of technology and innovative strategies to augment traditional infection control measures. At the crux of these advancements is the recognition that human error, in the form of inadequate sterilisation or incorrect handling, plays a significant role in the incidence of these infections.

One promising trend is the incorporation of antimicrobial agents into central line devices themselves, aiming to inhibit the growth of pathogens directly at the point of potential infection.³ This approach can supplement manual disinfection processes, serving as an additional layer of protection against CLABSI.

Another emerging trend is the development of advanced barrier caps, such as the ClearGuard HD antimicrobial barrier caps. These devices provide a physical barrier against contamination while also integrating antimicrobial properties.

The Role of ClearGuard HD Antimicrobial Barrier Caps in CLABSI Reduction

A standout innovation in the realm of CLABSI reduction is the ClearGuard HD antimicrobial barrier cap. This device is designed for use on Hemodialysis catheters, providing a combination of physical protection and antimicrobial action to help mitigate the risk of infection.⁴

The ClearGuard HD cap features a rod that is coated with chlorhexidine, a well-established antiseptic. When the cap is applied to the



ClearGuard™ HD Antimicrobial Barrier Caps are a simple, yet effective, tool to reduce hemodialysis catheter infections

catheter hub, this rod extends into the hub, providing ongoing disinfection while the cap remains in place.⁴ This mechanism not only offers a physical barrier to contamination but also ensures sustained antimicrobial activity, which can deter bacterial colonisation that could otherwise lead to a bloodstream infection.

In a randomised clinical trial involving more than 2,470 Hemodialysis patients, use of the ClearGuard HD cap was associated with a significant reduction in CLABSI compared to a standard cap.⁵ This result highlights the cap's potential to serve as an effective adjunctive measure in a comprehensive strategy to reduce CLABSI.

Other Emerging Technologies for CLABSI Reduction

While the ClearGuard HD cap represents a noteworthy advance, it is one of several emerging technologies aimed at reducing CLABSI incidence.

For example, needleless luer-activated valved connectors provide a physical barrier and continuous disinfection for luer access valves. Unlike ClearGuard, which uses chlorhexidine, these caps contain 70% isopropyl alcohol, offering an alternative for patients with chlorhexidine sensitivity.⁶

Another promising innovation is antimicrobial-coated catheters. These catheters are coated with antibiotics or antiseptics like chlorhexidine, silver sulfadiazine, or minocycline-rifampin, which inhibit the growth of bacteria on the catheter surface and thus reduce the risk of CLABSI. However, some research suggests

this approach is less effective in reducing CLABSI risk than hoped.⁷

Impregnated dressings are also gaining traction. These dressings, placed over the insertion site, can release an antimicrobial agent, such as chlorhexidine gluconate, to prevent skin flora from entering the bloodstream via the catheter.⁸

Lastly, the use of ultraviolet C (UVC) light devices to disinfect central line hubs and connectors is an area of active research.⁹ These innovations collectively represent the cutting-edge efforts to refine and enhance the approach to CLABSI reduction.

Comparative Analysis: ClearGuard HD and Other Technologies

Comparing ClearGuard HD caps with other emerging technologies highlights unique benefits and potential limitations. ClearGuard's chlorhexidine-coated rod offers continuous disinfection of the catheter hub, an advantage confirmed by a significant CLABSI reduction in published research.^{10,11}

Antimicrobial-coated catheters and impregnated dressings offer infection reduction directly at the insertion site, which is beneficial. However, they don't offer protection against contamination at the catheter hub.

UVC devices show promise for non-chemical disinfection, but their effectiveness is dependent on correct use, and further research is required.⁹

In conclusion, each technology presents unique advantages. ClearGuard HD caps stand out for their proven efficacy, although further

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Despite the promise of these technologies, adoption should be tailored to individual patient needs and integrated with existing infection control practices

innovation and research may strengthen the advantages of other methods.

The Future of CLABSI Reduction: Implications for Clinical Practice

As these new technologies, including the ClearGuard HD caps, become more commonplace, the landscape of CLABSI reduction is poised to evolve significantly. By offering continuous disinfection and reducing reliance on manual disinfection procedures, these innovations could potentially streamline infection reduction protocols and minimise the risk of human error.

Moreover, they may enhance patient safety and comfort by reducing the incidence of CLABSI, thereby decreasing associated complications and the need for additional treatments. For healthcare providers, this could mean reduced treatment costs and improved efficiency.

Despite the promise of these technologies, adoption should be tailored to individual patient needs and integrated with existing infection control practices. Their inclusion represents an advancement, not a replacement, of current protocols. As we continue to validate and improve these technologies, the future of CLABSI reduction looks progressively promising.

In conclusion, advancements such as the ClearGuard HD antimicrobial barrier caps represent significant progress in combatting CLABSI. While each emerging technology has unique advantages and potential limitations, their collective potential suggests an increasingly optimistic outlook for CLABSI reduction, promising improved patient outcomes and healthcare efficiency in the years to come.

ClearGuard™ HD is a trademark of ICU Medical, Inc.

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