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Patient Access

# Infection Prevention with Certofix® protect

Technical brochure of a non-leaching central venous catheter

# Microorganisms

## and catheter-related bloodstream infections

Reanimation and intensive care of critically ill and injured patients are not possible without the use of intravascular catheters. Although essential for such lifesaving interventions, implanted artificial materials inevitably bear the risk of bacterial contamination, infection and harm. Microbial contamination can lead to the formation of bacterial and fungal biofilms on the surface of implanted medical devices.[1]

In the hospital setting, the majority of catheter-related infections are derived from the patient' s own skin microflora.[2] The various microorganisms typically found on human skin are shown in the diagram below.[2]

The risk of infection is enhanced if a central venous catheter is inexpertly inserted or maintained. Catheter-related bloodstream infections (CRBSI) are associated with increases in mortality, morbidity and hospitalization costs for paediatric and adult patients.[6-10]

| | |
|---|---|
| Staphylococcus aureus | 15 % |
| Methicillin-resistant Staphylococcus aureus | <5 % |
| Candida species | <5 % |
| Enterococci | 2-4 % |
| Coagulase-negative staphylococci, such as Staphylococcus epidermis | 60-70 % |

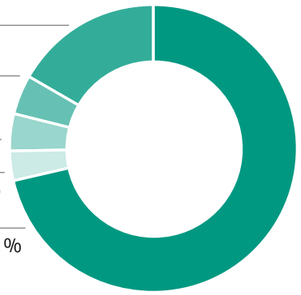


FIGURE 1 | Microorganisms and risk of catheter-related infections[2]

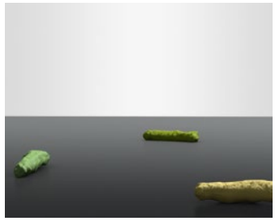
CRBSIs CREATE ADDITIONAL COSTS PER EPISODE RANGED FROM 4,200 € TO 13,030 €.[11]

### Pathogenesis of CVC infections

Contamination prior to and during catheteter insertion may result in catheter-related infections. The risk of infection is exacerbated if a central venous catheter is inexpertly inserted or maintained. Catheter-related bloodstream infections (CRBSI) are associated with increases in mortality, morbidity and hospitalization costs for pediatric and adult patients.[3-7]

These infections create additional costs per episode ranging from 4,200 € to 13,030 €.[11]
According to knowledge of microbial biofilm formation on catheter surfaces and its role in causing persistent infections and/or sepsis, the pathogenesis of catheter-related sepsis presumably follows these steps:

**1. Catheter insertion**



Initial attachment of microorganisms after insertion of an intravascular catheter.

**2. Microbial colonization**

Irreversible attachment of microorganisms.

**3. Biofilm formation**

The maturation of the microorganisms begins.

**4. Infection/Sepsis**

A release of offspring can lead to an infection development.

### Risks and limitations

Preventive strategies include measures such as antimicrobial line coatings, aseptic insertion technique, improved catheter maintenance, education of clinicians and reduced dwell time through early removal of catheters.[12,13]

As each patient pathway bears several risks and may have an unexpected twist the choice of the right catheter which is adequate for all therapy is very important.

**Dwell time**

- Approximately 75 % of patients have a catheter dwell time of less than 7 days.[14] These patients have the lowest risk of catheter-associated bloodstream infections.
- Clinical trials have demonstrated that higher dwell time is associated with significantly higher occurrence of central line associated bloodstream infections.[12,14-17]

**Efficacy in short insertion times**

Line coatings have been developed to reduce central venous catheter-related infections.

- Antibiotic and chlorhexidine-silver sulfadiazine coatings are anti-infective for short (approximately one week) insertion times.
  For longer insertion times, there are no data on antibiotic coating, and there is evidence of lack of effect for chlorhexidine-silver sulfadiazine coating.[10]
- For silver-impregnated collagen cuffs, there is evidence of lack of effect for both short- and long-term insertion.[10]

**Adverse reactions**

Antimicrobial impregnated central venous catheters can be divided into leaching and non-leaching catheter systems. Chlorhexidine or antibiotics may leach from catheter systems impregnated with such agents.

- Leached chlorhexidine and sulfadiazide silver may sensitize patients, leading to life-threatening anaphylaxis on subsequent exposure.[18-20]
- Antibiotic resistance after repeated exposure to minocycline and/or rifampicin-impregnated catheters can develop after bacteria have been exposed to subinhibitory concentration of antibiotics that have failed to eradicate these organisms. Some authors have reported in vitro resistance to leachable rifampicin or a combination of minocycline and rifampicin after repeated use of catheters.[21-23]

# Certofix® protect

## for optimizing catheter care

**Anti-pathogenic Certofix® protect catheters**

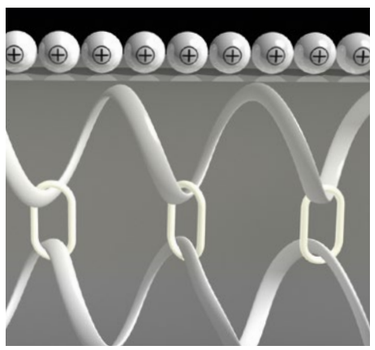
The protect coating creates a catheter surface with very good anti-pathogenic characteristics. The adhesion of bacteria, which is normally the starting point of a catheter-related bloodstream infection, is effectively prevented in this non-leaching catheter.

**The functional principle of Certofix® protect**

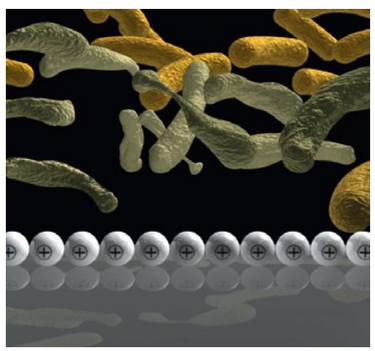
The polarization of the Certofix® protect catheter surface destroys the cell membrane structure of microorganisms in the event of surface contact. Ongoing chemical interaction between the catheter material (PUR) and the protect coating ensures long-term protection without leaching effect. Certofix® protect prevents catheter-related infections during the entire application period.[24]

USER BENEFITS

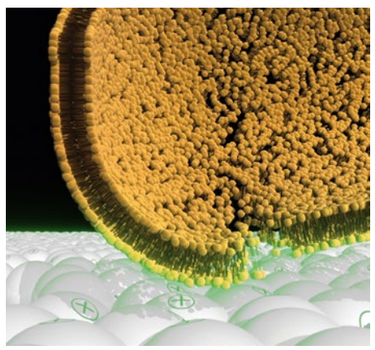
- A non-leaching antimicrobial central venous catheter
- No active agents are released, long time efficiency up to 30 days[24]
- The same flexibility as other Certofix® catheters
- Total catheter surface coverage – from tip to hub: On the complete inner surface and outside up to the channel junction



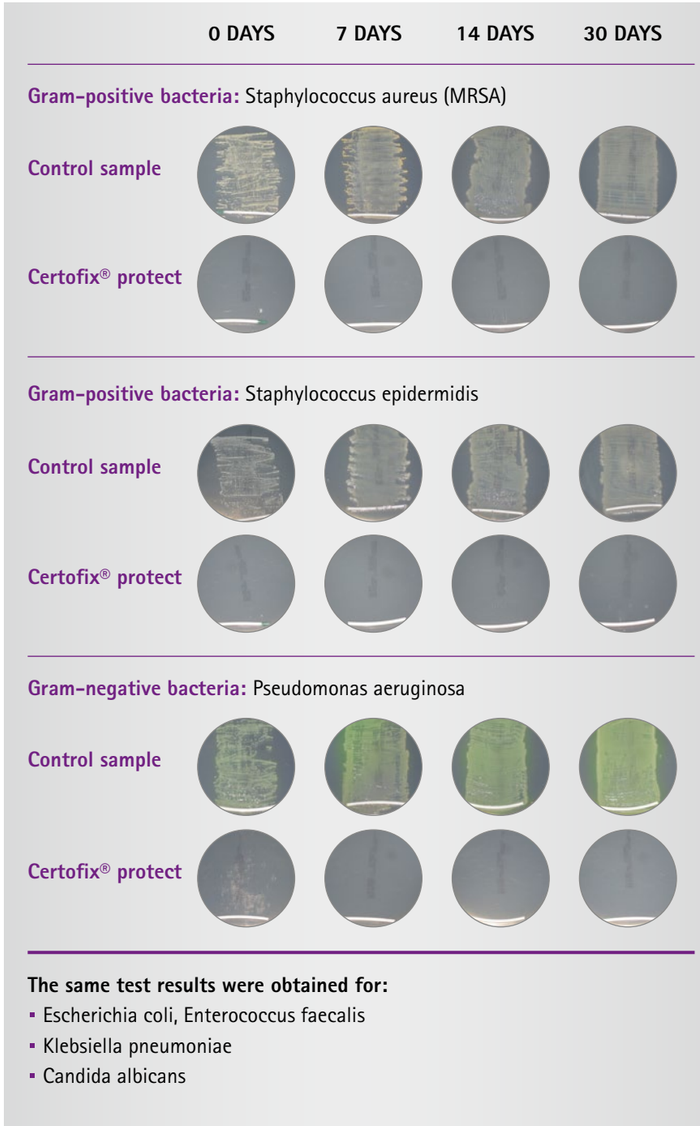
Ongoing chemical interaction between polarized catheter material and antimicrobial agent.



The antimicrobial inner and outer surface makes for a non-leaching catheter.



The cell wall structure of microorganisms is destroyed.




**The same test results were obtained for:**

- Escherichia coli, Enterococcus faecalis
- Klebsiella pneumoniae
- Candida albicans

Efficacy of Certofix® protect[24]

**Efficacy of Certofix® protect in long-term use**

The anti-pathogenic characteristics (30 days) of non-leaching antimicrobial central venous catheters on 7 typical CVC-associated infection bacteria was tested with the "Roll-Out" method, (Staphylococcus epidermidis, Staphylococcus aureus MRSA and E. coli, Enterococcus faecalis, Pseudomonas aerugionosa, Klebsiella pneumoniae and Candida albicans).

**"Roll-Out" test shows the following results**

- The in-vitro trial demonstrates that Certofix® protect exhibits antimicrobial efficacy and prevents biofilm formation from gram-positive, gram-negative bacteria and fungi for up to 30 days.[24]
- The study was performed in direct comparison with a non-antimicrobial control catheter, on which all 7 test strains were able to grow to an established surface biofilm.[24]

**Summary**

This is the first in-vitro study to demonstrate antibacterial surface activity and prevention of biofilm formation with antimicrobial, non-leaching CVCs by using the "Roll-Out" method over a period of 30 days. These results demonstrate that non-leaching antimicrobial CVCs can prevent microbial colonization and infection.

# Product Specifications

| Product Type | Mini Scalpel | Valve/Plug | Cath. Lumen ø G | Flow rate (ml/min)* | Length (cm) | Guide wire length (cm) | Code No. (REF) |
|---|---|---|---|---|---|---|---|
| **Mono V 320 Protect** | – | – | 16 | D 52 | 20 | 50 | 4160266P |
| **Mono V 420 Protect** | – | – | 14 | D 80 | 20 | 50 | 4160320P |
| **Mono V 330 Protect** | – | – | 16 | D 40 | 30 | 70 | 4160290P |
| **Mono V 430 Protect** | – | – | 14 | D 75 | 30 | 70 | 4160789P |
| **Duo V 715 Protect** | • | Safsite® Valve | 16/16 | D 60; P 50 | 15 | 50 | 4166159P |
| **Duo V 720 Protect** | • | Safsite® Valve | 16/16 | D 55; P 45 | 20 | 50 | 4161211P |
| **Duo V 730 Protect** | • | Safsite® Valve | 16/16 | D 52; P 37 | 30 | 70 | 4161319P |
| **Duo HF V 720 Protect** | • | Safsite® Valve | 14/18 | D 100; P 27 | 20 | 50 | 4168534P |
| **Trio V 715 Protect** | • | Safsite® Valve | 16/18/18 | D 50; M1 28; P 28 | 15 | 50 | 4162153P |
| **Trio V 720 Protect** | • | Safsite® Valve | 16/18/18 | D 46; M1 22; P 22 | 20 | 50 | 4163214P |
| **Trio V 730 Protect** | • | Safsite® Valve | 16/18/18 | D 38; M1 18; P 18 | 30 | 70 | 4163311P |
| **Trio HF V 1220 Protect** | • | Safsite® Valve | 16/12/12 | D 55; M1 165; P 165 | 20 | 50 | 4160622P |
| **Quattro V 815 Protect** | • | Safsite® Valve | 14/18/18/16 | D 50; M1 20; M2 20; P 50 | 15 | 50 | 4167767P |
| **Quattro V 820 Protect** | • | Safsite® Valve | 14/18/18/16 | D 40; M1 15; M2 15; P 40 | 20 | 50 | 4167775P |
| **Quattro V 830 Protect** | • | Safsite® Valve | 14/18/18/16 | D 35; M1 10; M2 10; P 35 | 30 | 70 | 4167783P |
| **Quinto V 1220 Protect** | • | Safsite® Valve | 16/18/18/18/12 | D 55; M1 28; M2 28; M3 28; P 185 | 20 | 50 | 4166868P |

***D** (distal); **M1** (middle1); **M2** (middle2); **M3** (middle3); **P** (proximal)

- The sales unit of Certofix® protect Sets is 10 pieces
- All catheters are made of PUR

The base material of the central venous catheter Certofix® protect is polyurethane (PUR). All lumens, including the hub and the outer surface of the catheter, are embedded with a long-chain polymer based on methacrylate. The catheter material also includes hydrophilic side groups such as polyethylene glycol and antiseptic polymeric biguanide.

# Literature


1. Satorius AE, Szafranski J, Pyne D, Ganesan M, Solomon MJ, Newton DW, Bortz DM, Younger JG. Complement c5a generation by staphylococcal biofilms. Shock. 2013 Apr; 39(4):336-42
2. Elliott TSJ. The pathogenesis and prevention of intravascular catheter-related infections. In: Hamilton H, Bodenham AR. Central venous catheters. Chichester [u.a.]: Wiley-Blackwell 2009; 206-209
3. Ebert T, Smith S, Pancari G, Wu X, Zorman J, Clark D, Cook J, Burns C, Antonello JM, Cope L, Nagy E, Meinke A, McNeely T. Development of a rat central venous catheter model for evaluation of vaccines to prevent Staphylococcus epidermidis and Staphylococcus aureus early biofilms. Hum Vaccin. 2011 Jun; 7(6):630-8
4. Walz JM, Memtsoudis SG, Heard SO. Prevention of central venous catheter bloodstream infections. J Intensive Care Med. 2010 May-Jun; 25(3):131-8
5. Mermel LA, Farr BM, Sherertz RJ, Raad II, O'Grady N, Harris JS, Craven DE; Infectious Diseases Society of America; American College of Critical Care Medicine; Society for Healthcare Epidemiology of America. Guidelines for the management of intravascular catheter-related infections. Clin Infect Dis. 2001 May 1; 32(9):1249-72
6. Yousif A, Jamal MA, Raad I. Biofilm-based central line-associated bloodstream infections. Adv Exp Med Biol. 2015; 830:157-79
7. Nakamura I1, Fukushima S2, Hayakawa T2, Sekiya K3, Matsumoto T4. The additional costs of catheter-related bloodstream infections in intensive care units. Am J Infect Control. 2015 Oct 1; 43(10):1046-9
8. Frampton GK, Harris P, Cooper K, Cooper T, Cleland J, Jones J, Shepherd J, Clegg A, Graves N, Welch K, Cuthbertson BH. Educational interventions for preventing vascular catheter bloodstream infections in critical care: evidence map, systematic review and economic evaluation. Health Technol Assess. 2014 Feb; 18(15):1-365
9. Rosado V, Romanelli RM, Camargos PA. Risk factors and preventive measures for catheter-related bloodstream infections. J Pediatr (Rio J). 2011 Nov-Dec; 87(6):469-77
10. Walder B, Pittet D, Tramèr MR. Prevention of bloodstream infections with central venous catheters treated with anti-infective agents depends on catheter type and insertion time: evidence from a meta-analysis. Infect Control Hosp Epidemiol. 2002 Dec; 23(12):748-56
11. The Joint Commission. Preventing Central Line–Associated Bloodstream Infections: A Global Challenge, a Global Perspective. Oak Brook, IL: Joint Commission Resources, May 2012. [Online]
12. Worth LJ, McLaws ML. Is it possible to achieve a target of zero central line associated bloodstream infections? Curr Opin Infect Dis. 2012 Dec; 25(6):650-7
13. O'Grady NP, Alexander M, Burns LA et al. Guidelines for the Prevention of Intravascular Catheter-Related Infections. CDC. Guidelines for the Prevention of Intravascular Catheter-Related Infections. Centers for Disease Control and Prevention. 2011
14. McLaws ML, Burrell AR. Zero risk for central line-associated bloodstream infection: are we there yet? Crit Care Med. 2012 Feb; 40(2):388-93
15. Milstone AM, Reich NG, Advani S, Yuan G, Bryant K, Coffin SE, Huskins WC, Livingston R, Saiman L, Smith PB, Song X. Catheter dwell time and CLABSIs in neonates with PICCs: a multicenter cohort study. Pediatrics. 2013 Dec; 132(6):e1609-15
16. Milstone AM, Sengupta A. Do prolonged peripherally inserted central venous catheter dwell times increase the risk of bloodstream infection? Infect Control Hosp Epidemiol. 2010 Nov; 31(11):1184-7
17. McLaws ML, Berry G. Nonuniform risk of bloodstream infection with increasing central venous catheter-days. Infect Control Hosp Epidemiol. 2005 Aug; 26(8):715-9
18. Guleri A, Kumar A, Morgan RJ, Hartley M, Roberts DH. Anaphylaxis to chlorhexidine-coated central venous catheters: a case series and review of the literature. Surg Infect (Larchmt). 2012 Jun; 13(3):171-4
19. Yasukawa T, Fujita Y, Sari A. Antimicrobial-impregnated central venous catheters. N Engl J Med. 1999 Jun 3; 340(22):1762
20. Oda T, Hamasaki J, Kanda N, Mikami K. Anaphylactic shock induced by an antiseptic-coated central venous catheter. Anesthesiology. 1997 Nov; 87(5):1242-4
21. Raad I, Hanna H, Jiang Y, Dvorak T, Reitzel R, Chaiban G, Sherertz R, Hachem R. Comparative activities of daptomycin, linezolid, and tigecycline against catheter-related methicillin-resistant Staphylococcus bacteremic isolates embedded in biofilm. Antimicrob Agents Chemother. 2007 May; 51(5):1656-60
22. Tambe SM, Sampath L, Modak SM. In vitro evaluation of the risk of developing bacterial resistance to antiseptics and antibiotics used in medical devices. J Antimicrob Chemother 2001; 47: 589-98
23. Sampath LA, Tambe SM, Modak SM. In vitro and in vivo efficacy of catheters impregnated with antiseptics or antibiotics: evaluation of the risk of bacterial resistance to the antimicrobials in the catheters. Infect Control Hosp Epidemiol 2001; 22: 640-6
24. J. Brunke, T. Riemann, I. Roschke, 30 days antimicrobial efficacy of non-leaching central venous catheters (Poster 063), Critical Care 2016, Volume 20 Suppl 2

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