

April 2023

## The importance of preoperative skin antisepsis in the prevention of surgical site infections

In 2016, the prevalence of nosocomial infections (NIs) was 5.13% in Germany, of which 22.4% were due to surgical site infections (SSIs). Based on this data, there is a statistical 1-2% chance to be affected by a NI associated with a surgery and, in turn, this may lead to an extended length of stay in the hospital by an average of 6.5 days. Treating an SSI also leads to additional costs of 3,000 euros on average.<sup>1,2</sup>

As 90% of all SSIs are endogenous, i.e., originate from the patients themselves, prevention primarily focuses on reducing the patient's own bacterial burden (pathogens).<sup>3</sup>

According to the definition of the Centers for Disease Control and Prevention (CDC), SSIs are infections that are related to the surgical procedure and occur within 30 days after surgery. For surgery with implanted prosthetics, this period is up to 90 days.<sup>4</sup>

Furthermore, SSIs are categorized depending on the depth of the infection and the involvement of organs.<sup>5</sup>

SSIs occur, if potentially pathogenic skin bacteria enter the site of surgery. Depending on the type of surgery, certain potentially pathogenic bacteria may be more prevalent. Most of the SSIs are caused by *S. aureus*. However, in abdominal surgery, mainly *enterococci* and *E. coli* are responsible for infection, whereas in cardiac surgery coagulase-negative *staphylococci* are prevailing.<sup>6,7</sup>

Skin disinfection with alcoholic preparations containing active compounds with residual activity reduces the risk for infection prior to surgery and, also prior to other invasive measures such as vascular catheterization. Therefore, preoperative antisepsis plays a key role in preventing SSIs and contamination of the surgical site with resident and potentially pathogenic bacteria.<sup>8</sup>



## The German KRINKO recommends...

...a thorough antiseptics of the skin of the surgical site **with an alcohol-based skin antiseptic** (Cat. IA). By adding an **antiseptic with residual activity**, a lasting effect beyond the effect of alcohol is achieved (Cat. IB).<sup>8</sup>

The use of alcohol-based skin antiseptics with residual antimicrobial efficacy for the preparation of the surgical site is state-of-the-art. The term residual antimicrobial effect describes the situation that the active antimicrobial ingredient remains on the skin even after evaporation of the alcoholic component and, thus, continues to provide an antimicrobial activity for an extended period of time. Octenidine (OCT), which is contained in octeniderm® colourless, is one of such residual antimicrobial ingredients with proven efficacy.<sup>9</sup>

This residual effect differs from the long-term effect of a purely alcohol-based antiseptic. Initially, a purely alcohol-based antiseptic, also exerts an antibacterial effect. However, as the alcohol evaporates and antimicrobial activity subsides, the bacterial count slowly returns to its original value over a period of time.

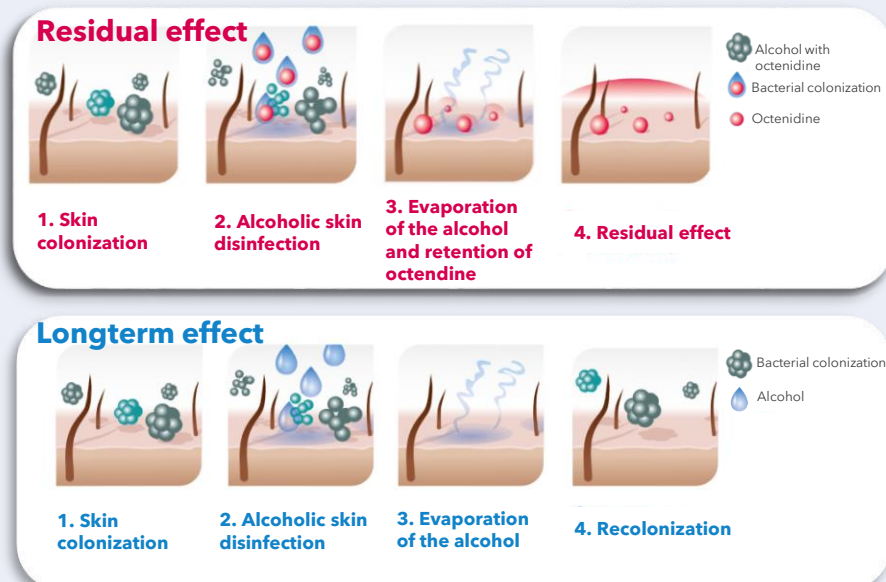


Figure adapted according to: Müller G. et al., Skin Pharmacol Physiol. 2014; 27(1):1-8

## OCT-containing alcoholic solution has the most pronounced effect with respect to preventing regrowth of resident skin flora



15 volunteers treated with different disinfecting solutions containing 1% PVP-iodine (PVP-I), 0.5% chlorhexidine (CHX), 2% CHX, 0.1% OCT or isopropyl alcohol (IPA) only

Melicherčíková et al. (2010) tested the residual effect of five different disinfecting solutions. Pure IPA served as a reference. The evaluation was made as described in the German guideline for evaluating skin disinfectants. Microbiological swabs were taken at different time points and colony-forming units (CFUs) were counted after incubation.

The regrowth of the resident skin flora after disinfection was statistically significantly higher for IPA than for the OCT-containing solution ( $p < 0.01$ ). Overall, none of the tested solutions had a more pronounced effect with respect to preventing regrowth of the resident skin flora than 0.1% OCT.<sup>10</sup>

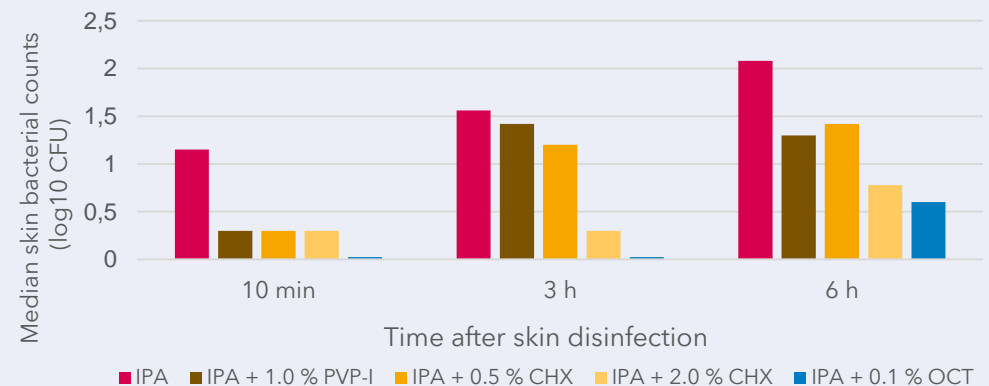


Figure adapted according to: Melicherčíková, V et al., J Hosp Infect. 2010;75(3):238-9.

## Residual antimicrobial effect of OCT and CHX demonstrated in reconstructed human epidermis (RHE) - *in vitro* model

Müller et. al. (2014) investigated the residual antimicrobial effect of OCT and CHX on RHE after topical application and after application of the test microorganism *P. aeruginosa* and *S.aureus*. Sterile water was used as a negative control.

For the test microorganism *P. aeruginosa*, added to RHE pretreated with OCT, the  $\log_{10}$  reduction was 2.6 after 24h. Similarly, when *P. aeruginosa* was added to RHE pretreated with CHX, the  $\log_{10}$  reduction was 1.6 after 24h. This demonstrated the residual activity of both active compounds due to the continued antimicrobial efficacy.

For the test microorganism *S. aureus*, no growth could be observed after 24 h.<sup>11</sup>

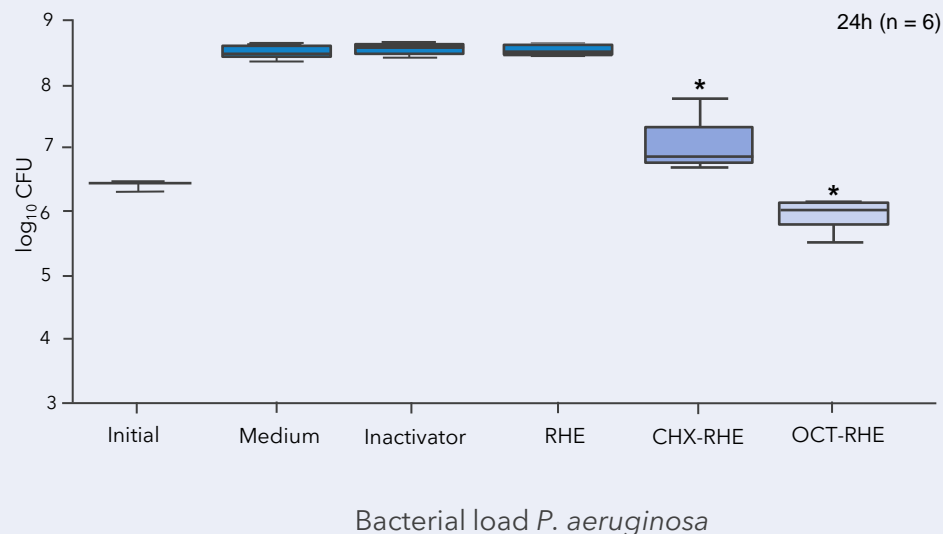


Figure adapted according to: Müller G. et al., Skin Pharmacol Physiol. 2014; 27(1):1-8

## Residual alcohol-based antiseptic more effective in reducing the bacterial count on insertion site colonization of intravascular catheters than pure alcoholic antiseptic



**Prospective clinical study, Department of Neurosurgery, University of Freiburg, Germany**



60 patients with placement of a central venous catheter (CVC) or peripherally inserted central catheter (PICC)  
 30 patients treated with OCT/1-propanol/2-propanol (group A)  
 30 patients treated with ethanol/2-propanol (group B)

Dettenkofer et. al. (2002) investigated the antibacterial efficacy of two alcoholic antiseptics, with or without a residual active compound (OCT). Prior to intravascular catheter insertion the antiseptics were applied at the insertion site. Microbiological swabs were taken at three different time points from an area of 24 cm<sup>2</sup>. Comparing group A vs. group B, median CFU values were 2,270 vs. 2,950 before surgery, 20 vs. 40 after surgery, and 860 vs. 1,210 24 h after catheter insertion. Hence, the solution containing OCT (group A) showed a greater residual and antibacterial efficacy than the alcoholic antiseptic only (group B,  $p=0,02$ , after 24 h).<sup>9</sup>

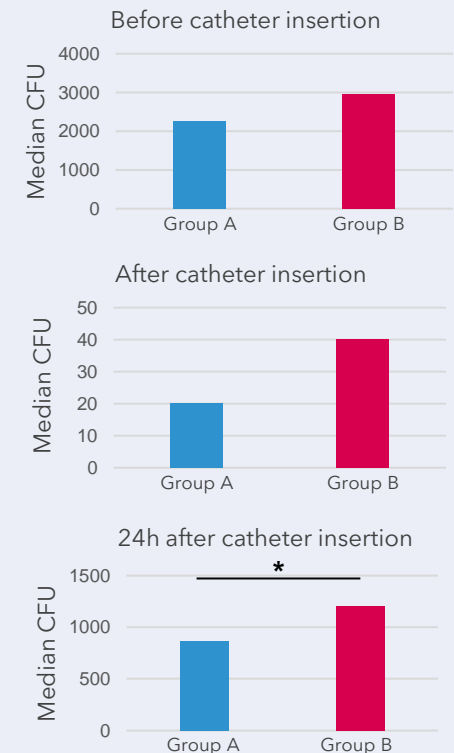


Figure adapted according to: Dettenkofer M. et al, Infection. 2002; 30(5):282-5

## The residual effect of OCT is more pronounced than the one of benzalkoniumchloride (BAC)



**Parallel, monocentric, prospective, triple-blind randomized study, analysis of bacterial counts at three different times.**



110 patients with planned use of a CVC and epidural catheter (EPC)

59 patients treated with antiseptic containing BAC

51 patients treated with antiseptic containing OCT

Lutz et. al. (2016) examined the antibacterial efficacy of two alcohol based disinfectants containing either BAC or OCT at the catheter insertion site (CVC and EC). After taking microbiological swabs, the bacterial load was analyzed at three different times: a) before catheter insertion, b) immediately after catheter insertion prior to sterile coverage and c) 48 h after catheter insertion. Immediately after disinfection a strong reduction in the bacterial load was observed for both antiseptics. After 48h, the bacterial load returned to the original level in the BAC-treated group.

In the OCT-treated group the recolonization after 48 h was statistically highly significant lower compared to the BAC-group ( $p = 0,0005$ ).<sup>12</sup>

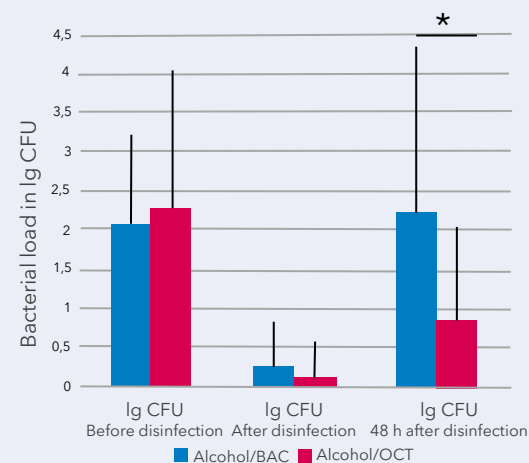


Figure adapted according to: Lutz et al., Infection. 2016;44(6):707-712

## OCT-containing alcohol-based antiseptic before knee or hip arthroplasty shows more pronounced antibacterial efficacy as compared to BAC-containing alcohol-based antiseptic



**Retrospective analysis of data from a prospective, monocentric cohort study**



200 patients with alcoholic antiseptic solutions

100 patients treated with antiseptic containing OCT

100 patients treated with antiseptic containing BAC

Böhle et. al. (2022) investigated the antibacterial effect of two different alcoholic antiseptic solutions containing either OCT or BAC before total knee and hip arthroplasty. The antiseptics with the residual active ingredients were applied on the skin prior to surgery. Subsequently, skin samples were taken from the surgical site and the cutis and subcutis were separated before processing and culturing on agar plates.

In the BAC group, there were 34 positive cultures (detections) as compared to only 17 in the OCT group. This corresponds to a 50% lower detection of a positive culture in the OCT group. The difference is statistically significant in favour of OCT ( $p = 0.005$ ).<sup>13</sup>

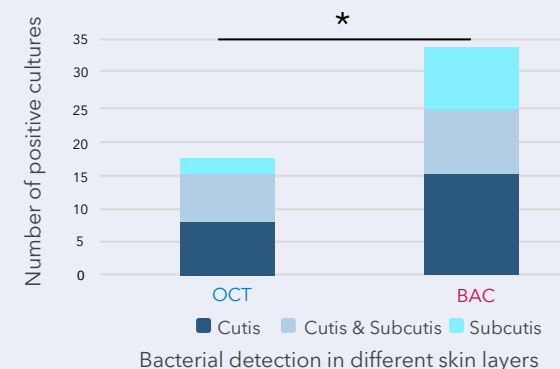


Figure adapted according to: Böhle et. al., Sci Rep. 2022;12(1):18246

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13. Böhle S et al., Sci Rep. 2022;12(1):18246.

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