# Prevention of Intraluminal Contamination of Intravascular Catheters

*Making the Case for Needleless Connector Disinfection with Chlorhexidine Gluconate / Alcohol*

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Despite a 46% reduction in central line-associated bloodstream infections (CLABSIs) in US healthcare facilities from 2008-2013, an estimated 30,000 infections continue to occur annually among hospitalized patients.[1] A common mode of pathogenesis for these infections is needleless connector contamination with microorganisms from the patient's skin and/or the hands of healthcare workers (HCWers). Inadequate disinfection of these connectors, which are accessed multiple times by HCWers in the provision of patient care, can result in intraluminal colonization of the catheter and subsequent bloodstream infection (BSI).

Although needleless connectors (NC) have been used for well over a decade and are recognized portals of entry for microbial contamination, the initial patient safety initiatives for CLABSI reduction focused on central line insertion practices. Process measures associated with catheter maintenance were not addressed. As healthcare facilities began to strive for "zero" CLABSIs, maintenance practices were adopted as additional quality metrics. A need for improvement with NC disinfection was cited by many healthcare facilities. For example, one institution reported that 31% of HCWers failed to disinfect the NC prior to access, even when under direct observation.[2]

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A contributing factor to variability in policies and clinical practice is the lack of an evidence-based guideline which defines the most effective needleless connector antiseptic and the duration of application. The 2011 Centers for Disease Control guidelines for the prevention of intravascular catheter-related infections[3] recommend minimizing contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine gluconate, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices.

The use of 70% isopropyl alcohol (IPA) wipes are most commonly used to disinfect needleless connectors using varying duration times, with 15 seconds being a frequently identified and recommended application.[4] However, investigators of this catheter maintenance practice found conflicting results. Menyhay and Maki performed a simulation study with needleless connectors heavily contaminated with *Enterococcus faecalis* and found that a conventional 3-5-second scrubbing with IPA was ineffective in eliminating bacterial transfer.[5] In a later paper by Rupp and colleagues[6], using *S. epidermidis* as the inoculum for an *in vitro* assessment as well as a clinical assessment of NCs, a 5-second IPA scrub was found to be adequate for disinfection.

The discordant findings associated with IPA disinfection alone, the advantage of immediate and sustained bacteriocidal activity of chlorhexidine gluconate/alcohol (CHG/ALC) and the **strong evidence supporting the use of CHG/ALC for skin antisepsis prior to the insertion of central catheters, led investigators to evaluate its efficacy for NC disinfection.**

## *In Vitro* Studies

- In the Menyhay and Maki study[5], an antiseptic barrier cap containing 2% CHG/70% IPA applied for 10 minutes essentially sterilized the heavily contaminated NCs and the finding was highly statistically significant (p = <.001) in comparison to 70% IPA alone for connector decontamination. No clinical studies were performed as the cap was never commercially marketed.

- Kaler and Chinn[7] compared the efficacy of 70% IPA alone versus 3.15% CHG/70% IPA for NC disinfection using a 15-second application time. Four types of needleless access ports were assessed and inoculated with *S. epidermidis, S. aureus, Pseudomonas aeruginosa* and *C. albicans*. The authors concluded that all models of needleless connectors were effectively disinfected with both antiseptics. However, this test design did not include a bacteria re-challenge over the period of testing to evaluate the persistence effect of CHG.

- Hong and collegues[8] compared NC disinfection with 3.15% CHG/70% IPA versus 70% IPA using scrub times of swipe, 5, 15 and 30-seconds. Common bacterial and yeast strains were used for inoculation. Important findings of this study include a) disinfection of the NC with CHG/ALC was superior to IPA alone for brief scrub times, which may simulate true clinical practice and b) Residual disinfectant activity was assessed, with CHG/ALC exhibiting activity for up to 24 hours after application compared to no activity for IPA alone.

• Flynn and colleagues[9] from the Alliance for Vascular Access Teaching and Research compared 70% IPA swabs to 70% IPA-impregnated caps to 2% CHG/70% IPA on three NC types for 5, 15, and 30-second application times. The IPA-impregnated caps were left on for 5 minutes. Test organisms included *S. epidermidis, S. aureus, Pseudomonas aeruginosa*, and *C. albicans*. Of note, the investigators attempted to simulate true clinical contamination by pre-coating one-half of the NCs with sterile human serum. Important findings include a) CHG/ALC swabbing for even 5-seconds outperformed IPA-impregnated caps and IPA swabbing and b) this study substantiates that 5-second IPA alone is inadequate for NC disinfection.

## Clinical Studies

• In this observational before/after study, Soothill and colleagues[10] changed from 70% IPA NC disinfection to 2% CHG/70% IPA on the pediatric hemopoetic stem cell transplant unit and monitored the occurrence of catheter-related bloodstream infections (CRBSI). The CRBSI rate declined from 12/1000 central line days to 3/1000 central line days (p= 0.004). Similar declines were seen with introduction on other wards

• Hayden and colleagues[11] at Rush Medical Center performed a prospective, randomized, blinded crossover clinical trial in a 24-bed MICU to evaluate whether disinfecting in situ central venous catheter (CVC) hubs with a 3.15% CHG/70% IPA preparation prior to access is superior to disinfection with 70% IPA alone in reducing hub contamination and if a 15 second scrub of in situ CVC hubs is superior to a 5 second scrub in reducing hub contamination. The disinfectant pads were blinded with hub disinfectant and scrub duration randomly assigned to each of 2 MICU wings. Important findings include a) 113/509 (22%) NCs were contaminated, and b) use of a 3.15% CHG/70% IPA prep pad was associated with less catheter hub contamination compared to disinfection with 70% IPA alone, which was statistically significant for the 5-second scrub time (p=<.001).

## Conclusion

It is anticipated that further clinical studies evaluating the efficacy of CHG/ALC for NC disinfection to reduce CLABSIs will be forthcoming. However, the current evidence is compelling and it may be time for the CDC Healthcare Infection Control Practices Advisory Committee to elevate the recommendation for its use as was done by the United Kingdom Department of Health when the National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England were updated in 2014.

About the author: Joan Hebden is currently a PDI Consultant. She received her baccalaureate and master's degrees from the University of Maryland School of Nursing. Joan served as the Director of Infection Prevention and Control for 28 years at the University of Maryland Medical Center in Baltimore, Maryland. An accomplished practitioner, she has presented at national epidemiology conferences, participated in research regarding the transmission of multi-drug resistant bacteria, contributed chapters on infection control to nursing resource texts, and published in medical and infection control journals. Joan is certified in infection control through the Certification Board of Infection Control and Epidemiology, is an active member of the Society for Healthcare Epidemiologists of America and the Association for Professionals in Infection Control and serves as a section editor and reviewer for the American Journal of Infection Control.

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