MaxZero™ and MaxPlus™ Needle-free Connector Technology Evidence Library

BD

Although one of the smallest components of your vascular access bundle, needle-free connectors (NFCs) are the vascular access catheter's microbial gatekeeper.[1] Colonization of a NFC is considered the cause of 50% of catheter-related infections.[2]

Outcomes can vary between NFCs and device selection may help reduce complications by accounting for potential variability in practice. The Infusion Nurses Society (INS) 2021 Infusion Therapy Standards of Practice recommend to "evaluate published outcomes of infection risks associated with each type of NFC when making product purchase decisions, focusing on risks, benefits, and education."[3]

This evidence library highlights some of the key peer-reviewed publications related to Max Needle-free Connector Technology and how it has assisted facilities in reducing catheter-related complications for over a decade.[4-15]

*CVC: Central Venous Catheter

Clinical benefits associated with CLABSI reduction

CLABSI may extend a patient's length of hospital stay up to 10 days and increase the odds of death up to 2.75X.[16-17]

Learn how the MaxPlus™ Needle-free Connector has demonstrated the ability to reduce CLABSIs.[4-6]

Tabak YP, Jarvis WR, Sun X, Crosby CT, Johannes RS. Meta-analysis on central line-associated bloodstream infections associated with a needleless intravenous connector with a new engineering design. *Am J Infect Control.* 2014;42(12):1278–1284. doi: 10.1016/j.ajic.2014.08.018.

MaxPlus™

CVCs

Study objective: To determine the CLABSI risk associated with a new NFC with an improved engineering design via an analysis of studies reporting CLABSIs with the positive-displacement NFC (study NFC, MaxPlus™ Needle-free Connector) vs. negative- or neutral-displacement NFCs.

Link: https://pubmed.ncbi.nlm.nih.gov/25465257/

Tabak YP, Johannes RS, Sun X, Crosby CT, Jarvis WR. Innovative use of existing public and private data sources for post marketing surveillance of central line-associated bloodstream infections associated with intravenous needleless connectors. *J Infus Nurs*. 2016;39(5):328-35.

MaxPlus™

CVCs

Study objective: To evaluate the possibility of monitoring hospital-acquired CLABSI rates potentially associated with IV NFC use by linking the publicly reported CMS hospital CLABSI data and IV NFC use data from a private source, the study NFC (MaxPlus™ Needle-free Connector).

Link: https://pubmed.ncbi.nlm.nih.gov/27598072/

Clinical benefits associated with CLABSI reduction

Wallace MC, Macy DL. Reduction of Central Line-Associated Bloodstream Infection Rates in Patients in the Adult Intensive Care Unit. *J Infus Nurs.* 2016;39(1):47–55. doi: 10.1097/NAN.0000000000000151.

MaxPlus™

CVCs

Study objective: To assess if a CVC insertion/maintenance bundle approach, including the MaxPlus™ Needle-free Connector, could impact CLABSI rates in the facility ICU.

Link: https://pubmed.ncbi.nlm.nih.gov/26714119/

Together, we can advance vascular care. Our experts can help you with assessments, products, training and education. Let's get started.

Economic impact associated with CLABSI reduction

Besides the harm they may cause to patients, CLABSIs are associated with increased healthcare costs.[18]

Learn how the MaxPlus™ Needle-free Connector has demonstrated savings by helping to prevent catheter-related complications.[7,8]

Costello JM, Morrow DF, Graham DA, Potter-Bynoe G, Sandora TJ, Laussen PC. Systematic intervention to reduce central line-associated bloodstream infection rates in a pediatric cardiac intensive care unit. *Pediatrics.* 2008;121(5):915–923. doi: 10.1542/peds.2007-1577.

MaxPlus™

CVCs

Study objective: To determine if an intervention involving staff education, increased awareness and practice changes (including use of MaxPlus™ Needle-free Connector) decreased CLABSI rates in a 24-bed pediatric cardiac ICU.

Link: https://pubmed.ncbi.nlm.nih.gov/18450894/

Royer T. Implementing a better bundle to achieve and sustain a zero central line-associated bloodstream infection rate. *J Infus Nurs.* 2010;33(6):398–406. doi: 10.1097/NAN.0b013e3181f8586b.

MaxPlus™

CVCs

Study objective: To assess if the implementation of several central line interventions (including use of MaxPlus™ Needle-free Connector) could achieve and maintain a CLABSI rate of zero.

Link: https://pubmed.ncbi.nlm.nih.gov/21079468/

Disinfection, contamination and colonization

Risk factors for infection include poor adherence to aseptic technique, needle-free connector (NFC) design variations, and inconsistent healthcare staff education and training.[2] Learn how the patented design of Max Needle-free Connector Technology aids in disinfection and helps to reduce the likelihood of bacteria entering the line.[9-12, 19-21]

Casey AL, Karpanen TJ, Nightingale P, Chaganti S, Elliott TSJ. An In Vitro Comparison of Microbial Ingress Into 8 Different Needleless IV Access Devices. *J Infus Nurs.* 2015;38(1):18–25. doi: 10.1097/NAN.0000000000000082.

MaxPlus™

In-Vitro

Study objective: To identify any differences between the rates of microbial ingress into 8 different NFCs following contamination.

Link: https://pubmed.ncbi.nlm.nih.gov/25545971/

Casey AL, Karpanen TJ, Nightingale P, Chaganti S, Elliott TSJ. Microbiologic contamination of a positive and a neutral displacement needleless intravenous access device in clinical use. *Am J Infect Control.* 2016;44(12):1678–1680. doi: 10.1016/j.ajic.206.06.027.

MaxPlus™

CVCs

Study objective: To investigate external and internal microbial contamination of a positive-displacement NFC (MaxPlus™ Needle-free Connector) compared to a neutral-displacement NFC (MicroClave™).

Link: https://pubmed.ncbi.nlm.nih.gov/27566872/

MaxZero™

PIVCs

CVCs

Hankins R, Majorant OD, Rupp ME, et al. Microbial colonization of intravascular catheter connectors in hospitalized patients. *Am J Infect Control.* 2019;47(12):1489–1492. doi: 10.1016/ j.ajic.2019.05.024.

Study objective: To assess the colonization of unprotected, open interface split septum catheter connectors (BD Lever Lock Cannula) and luer-lock catheter connectors (MaxZero™ Needle-free Connectors) with passive alcohol port protectors.

Link: https://pubmed.ncbi.nlm.nih.gov/31345614/

MaxZero™

CVCs

Clavier T, Ferguen M, Gouin P, et al. Impact of MaxZero™ needle-free connector on the incidence of central venous catheter-related infections in surgical intensive care unit. *Aust Crit Care.* 2019;32(2):107–111. doi: 10.1016/ j.aucc.2018.03.003.

Study objective: To explore the impact of MaxZero™ Needle-free Connectors on catheter-related infections (CRIs) in the ICU and study the global evolution of CRI rates from 2011 to 2016.

Link: https://pubmed.ncbi.nlm.nih.gov/29653801/

Want to learn more?

Follow this link to view a technical paper related to extended microbial ingress testing on MaxZero™ Needle-free Connector:

*PIVC: Periperially Inserted Venous Catheter

Catheter patency

Despite the practice of occlusion-preventing techniques, such as vigorous and pulsatile flushing, coordinated flushing with clamping, and locking, it has been estimated that catheter occlusion occurs in 25% of CVCs.[13]
Learn how the MaxZero™ Needle-free Connector can aid in reducing occlusions and improves dwell time.[13,14]

Williams A. Catheter occlusion in home infusion: The influence of needleless connector design on central catheter occlusion. *J Infus Nurs.* 2018;41(1):52-7.

MaxZero™

CVCs

Study objective: To obtain evidence-based practice data comparing catheter occlusion rates associated with the use of split-septum neutral-displacement NFCs (MicroClave™ Clear) to solid-surface zero-reflux NFCs (BD MaxZero™ Needle-free Connector).

Link: https://pubmed.ncbi.nlm.nih.gov/29293198/

Guenezan J, Marjanovic N, Drugeon B, et al. Chlorohexidine plus alcohol versus povidone iodine plus alcohol, combined or not with innovative devices, for prevention of short-term peripheral venous catheter infection and failure (CLEAN 3 study): an investigator-initiated, open-label, single centre, randomized-controlled, two-by-two factorial trial. *Lancent Infect Dis.* 2021. https://doi.org/10.1016/S1473-3099(20)30738-6.

MaxZero™

PIVCs

Study objective: To compare peripheral vascular care approaches for the prevention of complications leading to PIVC failure and assesses the efficacy of skin antiseptics for the prevention of catheter-related complications.

Link: https://pubmed.ncbi.nlm.nih.gov/33539734/

Learn more about the role of displacement

Gibson SM, Primeaux J. Do Needleless Connector Manufacturer Claims on Bidirctional Flow and Reflux Equate to In Vitro Quantification of Fluid Movement? *JAVA.* 2020;25(4):28–36. https://doi.org/10.2309/JAVA-D-20-00031.

MaxZero™

MaxPlus™

In-Vitro

Study objective: To evaluate if NFC manufacturer claims on bidirectional flow and reflux equate to in vitro quantification of fluid movement.

Link: https://meridian.allenpress.com/java/article/25/4/28/448981/Do-Needleless-Connector-Manufacturer-Claims-onw

Want to learn more?

Follow this link to watch a video about MaxZero™ and MaxPlus™ Needle-free Connector Technology.

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