

# Developing a Closed, Intravenous Medication System for a Neonatal Intensive Care Unit

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## BACKGROUND

The quality of neonatal intensive care is reliant upon a blend of nursing competency, techniques, and technologies each developed specifically for a specialized and fragile patient population. The importance of intravenous medication therapy in the care of these delicate patients is especially critical to their survival. Yet complications that arise from intravenous administration of medications and nutrition are a primary source of serious iatrogenic events such as medication errors and hospital-acquired infections.

To guide neonatal medication practice in the neonatal intensive care unit (NICU) at Women & Infants Hospital in Providence, Rhode Island, the facility established a multidisciplinary NICU Medication Task Force (MTF), consisting of representatives from Pharmacy, Nursing, Nursing Management, Risk Management, and Medicine.

## PURPOSE

After documenting a spike in central line infection rates and an increase in reported NICU medication errors, the MTF at Women & Infants took a series of proactive steps to reverse those trends. The purpose of this project was to seek to reduce infection rates and medication errors by replacing the positive displacement needlefree connector currently in use, as well as develop and implement a closed intravenous medication system to meet the specific needs of the NICU.

## MATERIALS AND METHODS

The MTF identified the MicroClave (ICU Medical, San Clemente, CA), a neutral displacement connector, to replace the positive displacement connecting device previously in use. The MicroClave was selected for its split-septum design—which has been noted by the Centers for Disease Control (CDC) as a preferred design feature for connectors—along with other design features including a straight fluid path and minimal dead space for effective flushing at low volumes, a smooth swabbable surface that facilitates more effective hub disinfection, as well as the MicroClave’s proven ability to provide a safe and effective barrier against bacterial transfer and contamination.

The next step in development was to create and test a model of the “closed medication IV system.” The task force worked collaboratively with ICU Medical to develop a custom IV set to meet the specific needs of the NICU, including a feature that would effectively close the IV system and limit the administration technique to a single delivery method with the fewest connections possible. Working from an initial design developed by a member of the task force, the ICU Medical custom set development team created multiple prototypes for clinical evaluation, followed by delivery of sterile sets for use in a patient trial. Each closed system prototype was tested on the MedFusion 2001 syringe pumps to ensure that the pumps did not alarm when administering a sample medication on the system. After evaluation and modification, a set was selected and implemented in tandem with the new MedFusion 3500 smart syringe pump on February 16, 2010.

Following the switch to MicroClave<sup>®</sup> connectors and the implementation of a new closed IV system and smart infusion devices, infection rates were reduced by 60 percent and medication errors decreased by 54 percent.

## RESULTS

In the first twelve months following implementation of the new closed IV system and smart infusion devices, the number of reported medication errors decreased 54 percent. Clinician data gathered during initial testing of the system and the first two years of full clinical implementation showed the number of reported medication errors and infection rates decreased from 5.0 infections per 1,000 line days in 2008 prior to implementation, to 2.0 infections per 1,000 line days in 2011—a 60 percent reduction in three years.

TABLE 1. Infection Rate Trend 2007–2011

Year	Infection Rate Per 1,000 Line Days
2007	5.6
2008	5.0
2009	3.1
2010	3.1
2011	2.0

## CONCLUSION

As the result of collaboration between the task force at Women & Infants Hospital and ICU Medical, the study concludes that the customized closed IV system met the unique needs of the NICU environment, allowing a standardization of the medication administration process that “fosters a high degree of nursing compliance.” In addition, the study concluded that the active engagement and involvement of the nursing staff in designing and training on the use of the system has resulted in “documented reductions in NICU infection rates and medication errors.”