Ensuring patient safety is a major goal of healthcare institutions; however, medication administration errors can present an obstacle to achieving this objective. Notably, 79% of harmful or fatal parenteral medication errors involve the intravenous (IV) route of administration, and 58% of parenteral errors occur at the medication administration step of the medication use process.\(^1\) Smart pumps can help reduce these errors and consequently, the use of these pumps has become an important strategic element in improving patient safety.

Medication error statistics, as mentioned above, have prompted Silver Cross Hospital, a 304-bed facility in Joliet, Illinois, to select a smart pump system to replace its aging infusion pumps. The hospital, a Thomson Reuters Healthcare \textit{100 Top Hospitals} National Award winner for six consecutive years, began evaluating smart pumps in 2009 for this purpose.

"Studies have shown that we can detect potential IV medication administration errors by utilizing smart pumps, so we knew we really wanted to have that technology because patient safety is our first and foremost priority," says Mary Brenczewski, RN, Silver Cross Administrative Director of Nursing Practice and Operations.

Silver Cross Hospital chose Baxter and the \textbf{SIGMA Spectrum} Infusion System to fulfill its infusion safety goals. The \textbf{SIGMA Spectrum} Infusion System not only offers Dose Error Reduction Software (DERS) like other smart pumps, but also provides unique Generation 2 safety features, which can avert errors that DERS alone would miss, including:

- Single Step Titration Error Prevention
- Check Flow at Start of Infusion, and
- Secondary Infusion Container Check

Smart Pump Selection

Months of research led to Silver Cross Hospital's selection of the SIGMA Spectrum Infusion System. In January 2009, Silver Cross Hospital formed a products evaluation subcommittee, including all of the hospital's nursing directors, the director of materials management, and two members from the information technology (IT) department. The subcommittee reviewed materials from the ECRI Institute and other sources to determine criteria for evaluating smart pumps. Several subcommittee members also reached out to staff at other local hospitals to learn about their experiences with smart pumps. The Silver Cross subcommittee finalized the key desired features in a smart pump system as outlined below:

- Comprehensive drug libraries with limits on both continuous rates and bolus doses
- Software to indicate where and when clinicians trigger dosing limit alerts
- Two-way wireless communication capabilities, enabling pumps to send pump usage data logs to a network server and to receive updated drug libraries
- Easy training and expert support before, during, and after implementation

Smart Pump Assessment

Silver Cross Hospital started assessing smart pumps by conducting a hospital-wide pump fair. The June 2009 event gathered input from Silver Cross nursing staff, who evaluated the smart pump options based on criteria identified by the smart pump subcommittee. Results from the pump fair survey favored the SIGMA Spectrum Infusion System by a large margin. This can be attributed to the SIGMA Spectrum Infusion System smart pump design, which facilitates staff training and simplifies workflow with rapid, easy set-up, infusion programming, and troubleshooting. The ease of programming the SIGMA Spectrum Infusion System was discovered during the pump fair. “Typically, nurses assessing the SIGMA Spectrum Infusion System were able to finish their evaluations within a half hour, while other pumps required more time to determine if they met the selection criteria,” says Chris Duchene, RN, Silver Cross Clinical Educator.

SIGMA Spectrum Infusion System large, bright, color screen, provides easy visibility of alphanumeric characters, which also made the SIGMA Spectrum Infusion System the most popular choice at the fair.

Evaluation in the Clinical Setting

The next step of the smart pump assessment process involved a trial in the surgical unit and intensive care unit (ICU) with the two highest-rated pumps. “We thought those units would challenge the drug library a lot more than anywhere else in the building,” Duchene says. The trial was performed to thoroughly evaluate pump performance and allowed the surgical unit and ICU to add more drugs to the drug library than had been originally planned. “What we ended up doing was creating the library to be a little bit more specific, and putting in those things that the unit nurses see routinely,” Duchene says. “So we got a better picture of the pump, and I have to say that the staff liked the SIGMA Spectrum Infusion System so much, they didn’t want to try anything else.”
Silver Cross Hospital chose the **SIGMA Spectrum** Infusion System as its new smart pump infusion system due to the nursing staff’s strong favorable response to the trial. Silver Cross administrators opted for wireless capability to allow simultaneous, full-fleet drug library updates. Prior to using the **SIGMA Spectrum** Infusion System, changes to the hospital’s medication protocols (drug limits, rates, and other important details) were stored in a central computerized system. This required e-mail notifications to the nurses when medication protocols changed. With the **SIGMA Spectrum** Infusion System, all changes to medication protocols are incorporated into the pump drug library and transmitted wirelessly to all pumps in the fleet, ensuring consistent, safe infusion therapy practices facility-wide.

**Baxter Implementation Process**

In March 2010, Silver Cross staff began working with the Baxter Implementation team to assess the hospital’s infusion therapy practices and technical infrastructure before moving into the design, build, and test phases of **SIGMA Spectrum** Infusion System implementation. In April, members of pharmacy, IT, biomedical engineering, and nursing participated in a kick-off meeting in which the Baxter Implementation team members explained each department’s responsibilities during the implementation, with timelines for milestone completion.

**Master Drug Library Development and Testing**

The Master Drug Library (MDL) is the core component of the **SIGMA Spectrum** Infusion System and key to helping reduce pump-related adverse drug events and improve patient safety. Constructing a comprehensive MDL is critical to successful implementation of the **SIGMA Spectrum** Infusion System. Nneka Okafo, PharmD, the Silver Cross pharmacist assigned to this project, began working on the MDL build after the April kick-off meeting. “You have such a big project, that it’s important to have the company have somebody who is available to help,” she says. The Baxter Implementation team members demonstrated building the library, showing Okafo, who was already familiar with the pump, a few more tips.

To ensure that the MDL was complete and accurate, a team of facility nurses serving as Resource Clinicians/Super Users reviewed printouts of the MDL for their respective care areas and programmed simulated infusions on the pump. This review period allowed the Resource Clinicians to better learn and understand the functioning of the **SIGMA Spectrum** Infusion System pump. “The nurses looked at all the patients’ charts to see if they had captured all of the medications that they were seeing on the charts. I think that paid off tremendously because when we actually went live, we had very few changes to make,” said Okafo. The MDL development and review process proved to be a valuable learning experience for Okafo, too. “As you are actually doing the build, there are things that come up that you don’t really think about until you get to that point. I have to commend the Baxter Implementation team members. They were always ready and willing to help.”
Clinician Training

After finalizing the MDL, Baxter provided training for clinicians and other hospital personnel responsible for handling the SIGMA Spectrum Infusion System pumps. Baxter conducted training for eight days prior to the scheduled Go-Live date to support information retention among participants.

“Baxter really worked around the Silver Cross schedule,” Duchene says. Baxter instructors staggered classes to accommodate the shift times of nurses, with classes starting at 6 am and extra pumps brought in to accommodate walk-ins. The efforts of the Baxter Implementation team in coordinating and conducting classes to meet Silver Cross staff needs enhanced the effectiveness of the transition. “Our Vice President of Patient Care Services said she’s never been involved with such a high-tech piece of equipment that had so few issues,” says Duchene.

SIGMA Spectrum Infusion System in Clinical Practice

With the SIGMA Spectrum Infusion System as part of the daily clinical practice at Silver Cross, staff members remain pleased with their choice. The Medical/Surgical staff, who originally were reluctant to give up their old, familiar infusion pumps, were pleased to make the switch after their training proved that the new, lightweight pumps could easily handle their needs. Duchene notes that patients are also happy about the new pumps, which are light and easy to push.

In the pharmacy, the SIGMA Spectrum Infusion System bi-directional wireless communication capabilities have allowed Okafo to update the MDL several times since implementation with ease. “It doesn’t take long at all,” Okafo says.

Additionally, the SIGMA Spectrum Infusion System Continuous Quality Improvement (CQI) reporting capabilities, which allow Silver Cross to track infusion data, indicate that the SIGMA Spectrum Infusion System Dose Error Reduction Software (DERS) has been utilized by the nurses. Safety software compliance rates have been consistently high. “Four months after implementation, we have 98% compliance with DERS,” says Duchene. Data on user soft limit overrides has helped identify soft limit changes required for certain drugs in the MDL.

Perhaps the most important measure of success for the SIGMA Spectrum Infusion System at Silver Cross lies in the fact that the pump is performing as it was intended—protecting patients from potential infusion harm. “I had two nurses who wrote me e-mails saying ‘thank you so much,’” says Duchene. “Each of them could have potentially made a very critical error, and the SIGMA Spectrum Infusion System stopped them from making a dangerous error.” With these kinds of results, it appears that Silver Cross Hospital accomplished its mission to achieve new levels of patient safety—and more.

“Four months after implementation, we have 98% compliance with DERS.” – Chris Duchene, RN, Clinical Educator

Rx Only. For safe and proper use of this device, refer to the complete instructions in the Operator’s Manual. Please see manufacturers’ full Prescribing Information for Dobutamine.

Spectrum pumps are manufactured by Sigma and distributed exclusively by Baxter Healthcare Corporation.