New Knowledge Innovation and Improvements

In July of 2010, WellSpan Health System was the first health system in the world to implement Symbiq™ Infusion System and the CareAware® Infusion Management and Smart Pump Auto-Programming in a ten bed medical intensive care unit. Since the pilot with MSICU, the technology is now implemented in 90 beds throughout the YH. With involvement of leaders and critical care nurses, WellSpan partnered with the EHR vendor (Cerner Corporation) and the infusion device vendor (Hospira) in an Alpha partner relationship to invent a solution to provide near real-time streaming data from the vital measurement devices as well as from the IV infusion pumps. Infusion Management leverages the electronic physicians order, smart pump technology, and bar code verification to provide bi-directional, wireless communication between the smart pump and the electronic medical record resulting in a closed-loop, integrated infusion management system. Using a barcode system, information is electronically captured and transmitted between the infused medication, the infusion pump, and the electronic health record. This integration allows real-time analysis and documentation of clinical data which takes the clinician out of the role of data transcriber thereby removing manual steps fraught with error.

In addition to its use as a clinical workflow tool at the bedside, infusion management has also been deployed in the pharmacy department to enhance communication and efficiency. Through the implementation of this innovation solution, results of integrated infusion management include a reduction in medication errors, improved efficiency for nursing and pharmacy, and increased quality of care. Additional information about these breakthrough innovations are described in the white paper written by WellSpan- Gettysburg Hospital VPPCS/CNO and Clinical Transformation Officer Kris O’Shea

Purpose and background: Nurse involvement in the Smart Pump Selection Process:

In 2009, the current infusion devices (IVAC) were identified as being antiquated and biomedical staff was challenged with keeping them in safe operating condition. Knowing that linking infusion device technology to the EHR was a goal; efforts were made to evaluate infusion devices with that functionality potential. On June 4th, 2009, a team comprised of nurses, nurse managers, pharmacists, corporate patient safety officers, informaticists, and representatives from engineering met to review WellSpan’s need for new IV administration equipment that would allow for a higher level of patient safety as well as preparing for auto-programming and infusion management. Nurses throughout WellSpan evaluated the features of various models of IV administration equipment and the Hospira Symbiq™ Infusion System was chosen. This make and model was chosen primarily on its ability to support auto-programming and infusion management as well as some other safety features such as soft/hard limits of medication specific infusion speeds and the ability to have specific dose/rates based on the clinical care area (CCA’s) that the medication was being administered.

Medication Safety issues identified prior to use of Infusion Management:

Prior to implementation of infusion management, safety and efficiency data was collected to identify pre implementation findings. This was accomplished through direct observation, time studies and safety reporting system. The direct observation was performed in two intensive care units during the delivery of patient care. This was to measure the number of steps and time taken to document
discrete data element. Prior to the implementation of Infusion Management it took up to 42 clicks to manually program the IV pump and document the medication in the computer for a weight-based medication. Documentation for hourly vital signs, fluid volume, and titration took up to 14 computer clicks.

Methods and approach

With the CareAware® Infusion Management System, nurses no longer have to manually program the orders into the infusion pump, which takes valuable time and can potentially lead to dosing or medication errors. With the new system, electronically entered orders are associated with the correct patient and the infusion pump is programmed automatically via barcode scanning. The system offers important advantages that reduce documentation time and potential for errors, and improves monitoring and surveillance: The information exchange is accomplished through a common platform called CareAware iBus, which makes two-way communication possible between devices and the EHR. The EHR is able to display infusion information (medication, dose, and rate), as well as hourly volume infused and a continuous volume countdown based on information received from the infusion system. The communication path goes from Millennium (a Cerner data-driven process management system) to CareAware iBus to the Hospira MedNet™ safety software to the Symbiq™ pump, and vice-versa.

Evaluation goals were to measure nursing time required for infusion documentation and medication administration prior to launch and after launch. Findings would also take into account nursing’s opinions of the system, and its effects on nursing workflow.

Beginning in December 2009, components of the CareAware® Infusion Management System were implemented at WellSpan, and in January 2010, the Symbiq™ Infusion Pumps with Hospira MedNet Software were launched. In July of 2010, WellSpan went live with the infusion clinical integration with auto-documentation and Smart Pump auto-programming. The implementation of the Infusion Management pilot in MSICU was initiated in January 2010. The first several months, the nursing staff spent the majority of the time learning the new features of the pump. In addition, multiple members of the staff listed above spent time building the drug library of the device. It was this feature that would help elevate the patient safety standards related to infusion management medication safety. NK9EO.1
drug library, (NK9EO.2) was built by Cerner, Hospira a pharmacist and nurses from MSICU, and would provide safer practice not only for the patient but would assure the nurse of safe practice for their own piece of mind described nurse manager Lynne Moul BSN, RN-BC NM of MSICU. The nurses in the MSICU were provided with the new pumps and tubing to use via the manually programming method in preparation for the 7/28/2010 Infusion Management pilot go-live implementation. Since that time the Hospira pumps were distributed hospital wide and the design team made many revisions to the software and the infrastructure necessary to support Infusion Management. Infusion management has subsequently been implemented in CCU and TSICU. The benefits of auto programming (without Infusion management) are being used on Tower 2
The following are two narratives from MSICU nurses who served on the super user group Lindsay Magna BSN, RN, and Lynne Sanderson BSN, RN who describe the work that was done in the MISUC with actual patient situations.

Lindsay Magna BSN, RN, CNII

Previously, a patient in MSICU requiring CRRT needed 1:1 nursing care to facilitate the many medications, calculations, management of the dialysis, and critical thinking of titrating vasopressors, not to mention just caring for such a critically ill patient. Each hour, all of the pumps, which could be numerous, are cleared and output totaled. Calculations were then completed manually in order to adjust the CRRT machine. This process was not only time consuming, but also left much room for human error. It also left little room for this nurse to care for another patient because of the urgent need to be in the room at the top of the hour for a prolonged period of time. Since the initiation of infusion management, each hour the amount of fluids infused from each pump clears automatically into the computer along with vital signs from space labs. This allows the RN to simply verify the numbers, empty urine and make changes on the CRRT machine. In the intake/output section, the entire intake is added for the hour. So, rather than the calculations completed by hand, this process is computerized, this enormously decreases any room for error. Another advantage to infusion management in the CRRT patient is saving time. My colleagues and I have now been able have the RN caring for the patient with CRRT paired with another patient, something that was uncommon in the past. We are able to have more time at the bedside with each patient rather than clearing pumps and doing manual calculations.

Lynne Sanderson BSN, RN

An example of a prevented medication error using the auto-programming: 2 patients, both with Protonix 40mg IV @ 2100. The drugs were taken into each room. After scanning the first pt/drug I received a warning stating that the drug and the pt didn't match. Error prevented. There are other error messages throughout the program. Currently we are in the process of updating the drug library to include other safety measures. TSICU, CCU and Tower 3 are now using the auto-programming part of infusion management. The rehab hospital will begin using these features in April 2012. MSICU also has had the privilege of conducting tours from all over the world to see how Cerner, Hospira and our electronic charting work together for meaningful use of the computer. Initially, as with other new information or change, this was not received very well. Grumbling and complaining was heard throughout the unit. Everyone thought for sure they would never get the hang of using it. Ask any of us today if we would do without it...your answer...NO! When the system is down we don't like having to manually enter the vital signs or IV fluids. Safety becomes an issue. And the time it takes to chart increases. I like having the opportunity to affect changes in nursing.

The health profession has moved in the direction of electronic charting. Nursing has seen a tremendous shift from “paper” charting to electronic charting. At this time very little is left for nurses to chart in the paper chart. Nursing informatics council (NIC) has had a huge role in the formation of electronic charting and the technology that is currently being used. We meet once a month to discuss/resolve issues surrounding electronic charting, and the technology involved. If needed we meet in small groups and do meet more frequently when items were being rolled out to the hospital. The group is made up of bedside nurses from each unit of York hospital, Gettysburg Hospital and the new Rehab hospital. Also involved are the IT/programming and build team.

The MSICU nursing staff helped behind the scenes meeting with IT programmers, investigating a variety of equipment, meeting with pharmacy to establish a drug library including hard and soft limits for drugs, and testing at various stages of build. After the builds and testing are completed nurses had
training to become super users for what was being rolled out to the hospitals. Super users then educated staff at York and Gettysburg hospitals. In April 2012 the MSICU nurses also assisted during the opening of the new WellSpan Surgical and Rehabilitation Hospital (WSRH) as they went live with I Aware, Infusion management, Hospira pumps, IVIEW, and eMAR. With a click of a button the nurse can input the collected data into the patients’ electronic record.

The first part of infusion management is the collection of information concerning volume infused over the last hour. Again a click of a button takes the input data directly to the IVIEW intake section. This allows for more accurate and up to date intake information. This is an advantage in the ICU as you try to maintain intake and output levels. Nurses can see which part of the intake was from IV, blood antibiotics. Doctors like this feature as they can monitor the I/O from whatever computer they are at in a timely fashion. The next part of infusion management utilizes scanning the patient, the drug, and the pump with the use of eMAR. This is known as auto-programming. In the beginning the staff had to manually program the Hospira pump with the drug, volume to be infused, the rate of infusion. They also had to input pt weight, mcg /mg, ml, units. This allowed many chances for human error. The MSICU also had to change from the Hospira pump to the IVAC pumps as the rest of the hospital was not using these pumps. One more chance for error! Now our pumps input the patient weight from admission forms. After you scan the pt/drug you scan the pump. It automatically in puts the volume, rate, drug etc into the pump. This is a huge patient safety factor. This scanning gives you 2 patient identifiers, makes sure the correct pt gets the correct drug, the correct time and rate.

The pumps also have libraries built for each specific unit. This prevents medication from being given on an area that shouldn't be hanging that drug, another pt safety feature.

Who was involved:
Nurses were selected to participate in device selection, library design, workflow mapping for auto-programming and infusion management (current and future-state), and super user support:
Nurse Managers:
- Lynne Moul BSN, RN, NE-BC- MSICU
- Lorraine Bortner BS, RN- 5 Main
Clinical Nurse Specialist:
- Suzan Brown MS, RM, CCRN, CCNS
Clinical Educators:
- Melanie Kane BSN, RN
- Susan Hunter BSN, RN
Staff Nurses:
- Lynn Sanderson (MSICU),
- Dekey Tenpa (MSICU),
- Mary Keller (MSICU)
- Kristen Thompson (IV Team)
Medication Process Specialists:
- Laura Kurish RN,
- Sueanne McKniff BSN, MBA, RN
Clinical Informatics Nurse:
- Renee Howard BSN, RN
Coordinator Nursing Informatics:
- Sharon Muller MSN, RN

Clinical Transformation Officer:
- Kris O’Shea MS, RN, NEA-BC

Materials Management
- Doris Pope MS, RN

Non-nursing team members
IT analysts: Larry Baker, Angie Jowanowitch, Tammy Mummert
Pharmacists: Donald Gerhart, Dave Weaver, Rick Martin
Engineering / Bio med: Tom Keller, Chad Noll

Outcomes and Benefits:

<table>
<thead>
<tr>
<th>Time Saved to Begin Infusion (average)</th>
<th>Time Saved to Titrate Infusion (average)</th>
<th>Time Saved for Post-Code Documentation</th>
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</thead>
<tbody>
<tr>
<td>After Infusion... 44  60  Before Infusion... 0  20  40  60  80</td>
<td>After Infusion... 13  26  Before Infusion... 0  10  20  30</td>
<td>After Infusion... 5  120  Before Infusion... 0  50  100  150</td>
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**Before Infusion Management Implementation July 28, 2010—After Infusion Management Implementation January 2012**

1) A 27% reduction in nursing time required to start and document each new “begin” infusion
2) A 50% reduction in nursing time required to titrate an existing infusion and document it
3) Post-Code Documentation was able to be completed by the nurse in 5 minutes using infusion management instead of the 120 minutes

The time reduction of 13 seconds per titration may equate to approximately 1,300 nursing hours per year. One area that resulted in a tremendous time-savings, as shown in one instance, was the follow-up documentation required following a code blue (high acuity/cardiac arrest situation). Retroactive charting can be very time-consuming, taking up to 120 minutes. Because the CareAware® System pulled information directly from the infusion pumps during the code and automatically correlated it with physiologic and hemodynamic parameters from cardiac monitors, the data were recorded automatically in CareAware® Infusion Management. Post-code documentation took the clinician 5 minutes instead of 120 minutes, without the need to gather information from memory or random scraps of paper.

Benefits, other than time savings were also realized as a result of the implementation of Infusion Management. Medication safety has been enhanced due to less potential for transcription errors because 81% of the time nurses successfully auto-program the pumps. This eliminates the errors identified during manual programming of pumps. During the period between July 1, 2011 to January 31, 2012, 90 near-miss medication errors were identified and prevented. The nurse attempted to program outside of an acceptable dose/rate range which was prevented by the safety software on the pump. Based on industry standards a possible 10% of these programming errors would have
reached the patient resulting in 9 potential adverse drug events during this period. Resulting in an estimated cost savings of more than $77,000 and a potential savings of more than $132,000 per year for one 10 bed ICU.

Anecdotal Nursing Opinions

**Acute situation:**
- Patient was coding; nurses began several infusions
- After patient stabilized, pumps were associated to patient; all data moved automatically into infusion management system
- Nurse documented the code in 2 minutes; previously would have taken 1 to 2 hours
- Work was accurate (not recalled from memory or gathered from scribbled notes)
- Efficiency and accuracy!

**Critical thinking**
- Nurse in MICU described a patient who was very unstable with multiple infusions running
- With infusion management capturing titrations and volumes, he had adequate time to review patient’s clinical presentation, diagnostic and physiological data, trends, and diagnostic results all in one view
- This enabled him to realize quickly that patient was not responding to antibiotics; physician was called for additional diagnostics
- Nurse says his patients are safer because of this solution

**Nurse Comments**
- “We have been waiting for something like this.”
- “I feel like a kid on Christmas morning.”
- “This is awesome – 10 clicks down to 2. Now all I have to do is take care of my patient.”
- “This is a little piece of heaven.”
- “No more paper towels.”
- “It does everything but start the IV.”

**Award Presented to WellSpan**
- WayPaver award was presented by UnSummit in recognition of the first-ever collaborative award to hospital/vendor (WellSpan, Cerner, and Hospira) for the innovative work to advance the use of bar-coding technology in enhancing patient safety through the development of Infusion Management.

Pictured above: Lee Maddox MD, Keith Noll President of YH, Nursing staff from MSICU, Chip Gerhart Pharmacy Patient Safety Officer, Hal Baker MD, CIO, Sueanne McKniff Medication Process Specialist.
There are several areas of improvement that have come about as a result of the implementation of the Hospira (need TM) pumps for the delivery of IV infusions and medications. Most importantly has been the improvement in safety for the patients who are receiving them. In addition, there have been several items that improved delivery of care and workflow for the nurses caring for the patients. Following is one example of how nursing care has been impacted.

CareAware® Infusion Management and Smart Pump Programming combined with Symbiq™ Infusion System with Hospira MedNet Software have provided WellSpan with enhanced infusion administration. The new technology provides near-real-time streaming data that enhances clinical decision-making, reduces infusion administration time for nurses, which improves workflow; and helps prevent manual programming errors, which improves patient safety. The safety software integrates the technology capabilities so that nurses do not have to select a drug from the library; rather it is automatically programmed for a given patient. The software safety limits, which are defined by the institution, prevent over- and under-dosing of drugs, especially important for high-risk drugs. Reports provide an opportunity to review infusion practices. Data can be collected over specific time periods and locations, which can help identify areas that need education. The reports also support proactive planning to enhance IV medication administration in a specific unit or throughout an institution.

The technology does not replace the important work that nurses do; rather, it allows them to use their skills directly on patient care. As one nurse put it, “We have been waiting for something like this.”