

Intelligent Infusion Technology: Making Advances in Patient Safety



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The background of Jim Tillery, RPh, MS spans more than 25 years in hospital pharmacy practice as well as the Medical Supply/ Device Industry with a focus on product development. At Hospira, Jim serves as commercial lead for the design and development of the Hospira MedNet® System and has worked on developing (Symbiq®) and augmenting (Plum A+® and LifeCare® PCA) Hospira infusion pumps to accommodate enhanced patient safety features.

Additionally, Jim serves as the moderator for the continuing education CD-ROM for nurses and pharmacists entitled *Detect, Correct, and Prevent Medication Errors with Intelligent Infusion Technology*.

Hospital executive management teams are familiar with the data on medication errors in hospitals and the challenges presented by them. The number of incidents has grown dramatically, as have the associated costs for institutions across the country. In 2006, the Institute of Medicine reported that medication errors occur at the rate of one per patient per day in U.S. hospitals.¹ Each adverse event due to a medication error costs an additional \$8,750 for an individual hospital stay—or about \$3.5 billion annually.¹ And nearly 7,000 deaths each year can be attributed to medication errors.¹

No matter how attentive clinicians are in assuring that the right dose of the right drug is delivered to the right patient, mistakes occur. A slip of the finger, a double keystroke—it doesn't take much for a small mistake to grow into a difficult situation for patient and institution alike.

To address one set of these issues—intravenous (IV) medication errors—researchers have developed specialized software that can result in safer, easier, more efficient IV medication administration.

What is intelligent infusion technology?

Intelligent infusion technology is partly comprised of specialized software (also referred to as safety software) designed to work with "intelligent" IV pumps—both general infusion and patient-controlled analgesia (PCA) devices—at the bedside. The software is designed to monitor pump programming, collect data for benchmarking and evaluate and help improve an institution's IV medication practice process. Specifically, the system can:

- Potentially prevent IV administration errors and adverse drug events (ADEs).
- Quickly alert a clinician in the event of an error or ADE so rapid response can be implemented.
- Record data that can be analyzed for multiple purposes within the institution, from drug-use evaluation to continuous quality improvement (CQI) initiatives.

The software can also be used to establish a link between pharmacy, point-of-care infusion devices, and other information systems within the hospital to provide even greater capabilities in patient safety, recording and maintaining medical records, and billing.

How does it work?

The following provides an overview of the IV administration process once an intelligent infusion system has been installed in the hospital. (The process for a PCA device is similar, though, for obvious reasons, not exactly the same as for a general infusion device.) Capabilities can be customized to meet each institution's needs.

- An IV drug is prescribed for the hospitalized patient and transmitted to the pharmacy manually or electronically.
- The prescription is then prepared in the pharmacy.
- The nurse receives the order, retrieves the medication and programs the "intelligent" pump.
 - This entry accesses the drug library, which contains drug preferences and dosing parameters customized by the hospital for each patient care area (such as ICU, Med-Surg, Peds, etc.). Once the drug, dose, rate and volume to be infused are entered, a confirmation screen appears.
 - *Caution* with the Plum A+® infusion system: if the bedside caregiver does not access the drug library, the infusion will be administered with no safety limits in place.
 - If the facility is using the Symbiq® infusion system, the software assures compliance due to a drug default setting (unless the user overrides the function).
- The infusion is started when the nurse confirms that all of the data is correct and presses the "Start" button on the pump screen. If the clinician has programmed a dose outside the hospital-specific drug library limits, deviating from the established patient safety parameters, an alert is triggered.
- Every transaction at the pump—including the dose and drug delivered, an override of a dosing parameter, a pump alarm incident and more—is recorded and can be formulated into standard reports. These reports may be used by the hospital to define areas that need attention, to monitor software compliance and to provide a basis for CQI projects.

What are the benefits for a hospital?

First and foremost, as noted earlier, intelligent infusion technology helps reduce IV medication errors and improve patient safety. But there's more: It can also help enhance clinical workflow, increase staff productivity, promote caregiver confidence, improve IV administration best practices, support asset management, potentially reduce in-facility costs associated with medication errors, and assist with performance enhancement efforts (CQI). In addition to the benefits provided to both the facility and its staff, this kind of advanced technology can also make an important difference in patient confidence in an institution.

Technology that can be scaled to meet needs today...and tomorrow

Technology for healthcare is necessary, costly and continually evolving. This can put pressure on an institution's administration: What is vital today? What plans need to be made for the future? Is obsolescence a problem? What is the required capital investment, and how should it be distributed? These are not small issues for administrators who are responsible for an institution's health while simultaneously balancing the need to provide excellent healthcare to patients.

With these priorities and improvements in mind, a tiered, scalable intelligent infusion software system with open architecture is a good choice to meet patient safety needs within budgetary constraints. Before deciding on the technology that is right for an institution, a thorough analysis of current IT capabilities is a necessary prerequisite. A hospital must be IT-ready for this kind of system to be installed, which, in some cases, may mean upgrading an institution's current IT capabilities before proceeding with implementation. With a scalable system, this technology can be installed at a level to meet today's needs, with the opportunity and flexibility to upgrade and add additional functionality to build a more comprehensive system over time.

For example:

A hard-wired approach. A hard-wired approach offers medication error prevention capabilities for hospitals whose administrators understand the value of an intelligent infusion system, but must begin with a system that matches their IT capabilities and budget. Safety software functionality is provided, including the ability to create and manage drug libraries using the hospital's drug formulary, transfer of drug libraries to the devices, and capture and storage of historical data for analysis and reports.

This hard-wired system includes a system server, safety software and "intelligent" infusion devices. These devices are physically interconnected to the hospital network to communicate with the safety software server. A hard-wired system may be upgraded with wireless technology when the facility is ready.

Wireless, with a combination of hard-wired and wireless connections. Hospitals with an existing wireless infrastructure may choose a wireless intelligent infusion system or a combination of wireless and hard-wired connectivity. There are numerous benefits to such a system: drug library updates can be transmitted more frequently and more easily; infusion data may be frequently transmitted to the server and therefore be more readily accessed; asset management will be improved; and a patient's IV status can be monitored (in near real time).

In addition, there can be an integration with an automated nurse callback/voice-paging system, and integration with the hospital or pharmacy information systems (HIS/pHIS).

This system includes the server, safety software and "intelligent" infusion devices. With a wireless system, infusion devices can directly connect to the Hospira MedNet® server. A wireless system should include 802.11a/b/g and 802.11n capabilities for maximum flexibility and the latest industry standards for wireless security.

Wireless with enhanced programming capability.

Integration of the intelligent infusion system with the hospital's information system, including bar-code point of care (BPOC), electronic medical administration records (e-MAR) and the use of the pharmacy information system (pHIS), results in patient safety and clinical workflow. When the facility has BPOC systems, the patient's 5 Rights (right drug, right dose, right time, right patient and right route) are verified.

Wireless connectivity that has enhanced programming capabilities requires a server, intelligent pumps with safety software, and interoperability with BPOC devices, including bar-code scanners and PDAs. Hospitals considering going wireless should keep these points in mind:

- The selected wireless technology must meet appropriate industry standards (such as those from the IEEE [Institute of Electrical and Electronics Engineers] and the Wi-Fi Alliance).
- Network infrastructure design considerations should include choice of wireless frequencies (802.11a, b, g, and/or n), areas of use, density and type of wireless networking devices or access points.
- A properly designed wireless system also takes into account all of the types and capabilities of wireless devices that will use the wireless network, from MRI/CAT scanners to EKG monitors, PDAs, wireless phones (or any communication devices), computers and wireless infusion devices. For proper functioning, an institution wants to be sure there's enough bandwidth to accommodate needs, and no interference that can adversely affect the operation of these devices.
- Security is essential. Ensure that the wireless system installed in the institution meets Health Insurance Portability and Accountability Act (HIPAA) guidelines. The system must also meet wireless industry standards, including authentication and encryption schemes.
- Wireless implementations vary widely by capabilities, price and performance. Internal IT personnel should carefully evaluate to ensure that specific needs—for today, and the future—are met.

All that private information stored in one place may seem vulnerable. But with technological capability comes technological protection. Safeguards are taken to ensure that the system itself cannot be accessed without authorization; hence protecting the stored data, and transmission from the server to the pump and between integrated systems is secure. Passwords, keys, encryption and defenses against electromagnetic interference are all security options, with the capability to be used redundantly, depending on an institution's needs.

From the start, involve everyone

Once a decision has been made to install an intelligent infusion system, it is important to allocate adequate resources for planning, implementing and monitoring on a continuous basis. This will help ensure maximum return on investment.

To achieve maximum efficiency and effectiveness, personnel from numerous disciplines must be involved and should be given flexibility and relief from regular work assignments so that implementation results in minimal disruption to patients and normal clinical workflow. Usually, clinical and implementation "champions" will be designated to provide leadership during planning and implementation.

- **Nurses.** Nurses are the end-users of this technology and must be part of the process from the beginning. They bring valuable insight into practices at the bedside and the needs that must be met to optimize efficacy of an intelligent infusion system.
- **Pharmacists.** As authors of the drug library, they assure accuracy of drug information, help determine dosage limits and monitor and update drug library content on an ongoing basis.
- **Information Technology (IT).** IT personnel help ensure that the institution's computer and network capabilities accommodate the software system, maintain the computer and network infrastructure, support system security and prepare the system for upgrades.
- **Biomedical Staff.** Biomedical personnel set up, maintain and track devices and support technology upgrades.
- **Materials Management.** These personnel ensure that necessary equipment and materials are available when needed and supply materials on a timely basis.
- **Physicians.** The role of physicians varies by institution and by Pharmacy and Therapeutics (P&T) committee policies, but physicians can play an important role in helping build the drug library. They may also electronically initiate infusion orders in institutions that accommodate a computerized physician order entry (CPOE) system.

- **Executive Management Team.** The roles of the chief officers are to request and approve budgetary funds necessary to drive the institutions' patient safety vision and guide their institutions to maximize patient care.

When an institution decides to implement intelligent infusion technology, several weeks to a few months may be required for planning and implementation; the process should be methodical and systematic throughout. A good plan will define task teams, assign personnel, evaluate hardware and software capability (as defined previously), assess current policies and practices (a critical component in developing an effective drug library), develop a training plan for nurses, pharmacists and other personnel, and define the sequence of events for the day that installation will take place.

A good plan will also provide adequate time for education. It is important to allow enough time away from regular duties for pharmacy and nursing personnel to learn the software, and, most critically, to build the drug library. This is the heart of the system and requires consultation and agreement between pharmacists, nurses and other hospital personnel. In addition, mandatory training for nurses (also separate from regular responsibilities) is necessary and can be accomplished over a few weeks.

A well-designed plan will gain support among staff who will be using the intelligent infusion technology, and continually reinforce the advantages to clinicians, patients and the institution that the system can potentially help prevent IV medication errors.

Implementing intelligent infusion technology is no small endeavor. But the investment in time and personnel, as well as hardware and software, will be realized in a system that can help prevent medication errors and improve patient safety.

Now you've got all that data...what are you going to do with it?

The intelligent infusion system collects a wealth of data. From this data, various reports can be created that can help provide answers to questions like: Are clinicians utilizing the intelligent infusion software? Which doses of which medications are frequently overridden? What practice trends

do you see? Are errors more prevalent in one care area than another and are they more prevalent with particular medications, and if so, why? Are there educational opportunities for the medications associated with the critical catches? How much of a particular drug is used by a particular unit? Are there too many concentrations of a single drug in your library, or not enough? Is it time to update the library with new medications or changes in dosing limits?

The system is an ongoing, ever-present means of continually evaluating and upgrading a hospital's performance and impact on patient safety. To make the most of the data, regular evaluations by nurse administrators, pharmacy, risk management, the drug library transfer team, P & T, or a combination of personnel is essential to determine how to make the most of the information gathered.

The bottom line

The costs of implementing an intelligent infusion system vary by institution, existing capabilities and institution objectives. A prudent, prospective institution should take into account IT infrastructure needs, software and pump requirements and software licensing and maintenance budgeting needs when considering investing in an intelligent infusion system.

With proper planning and efficient implementation, the benefits will be readily apparent: an intelligent infusion system can help reduce medication errors, improve patient care, reduce in-facility costs and support asset management. It can enhance continuous quality improvement efforts and help improve clinical workflow. In addition to improving the bottom line of an institution, this technology will support the confidence of every person who interacts with the system: the caregiver, the patient and the community your institution serves.

REFERENCES

1. Aspden P, Wolcott J, Bootman JL, Cronenwett LR, eds. *Preventing Medication Errors: Quality Chasm Series*. Committee on Identifying and Preventing Medication Errors. Institute of Medicine, 2006.

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