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Increase the IQ of Your Smart Infusion Systems

Using Wireless Technology to Maximize Safety and Efficiency

A comprehensive review of wireless smart infusion technology must reveal its known and potential consequences.

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Purchasing a smart infusion system can be a complex and daunting task. After sifting through numerous purchase criteria, you must determine whether or not to invest in the wireless functionality now offered with most of these systems. By carefully considering the features and functions currently available in smart infusion systems, you can select the appropriate product for your facility. (Download the recent article, "Purchasing Smart Infusion Systems," at www.pppmag.com.) Furthermore, in taking the time to understand and implement wireless networking capabilities in conjunction with your smart infusion systems, you will reap a number of patient safety and workflow efficiency benefits.

Current System Design and Capabilities

Through the use of customizable dose-error reduction software (DERS), smart infusion systems are designed to alert programming clinicians when they have exceeded an infusion's upper or lower dose, rate, or duration limits. Typically, facilities can establish hard limits (i.e., clinicians are given no other option except to reprogram or opt out of the DERS) and/or soft limits, which give clinicians the option to override the alert or reprogram the pump within the established limits. Additionally, some vendors now offer integrated PCA pause monitoring through end-tidal carbon dioxide ($EtCO_2$) monitoring and pulse oximetry (SpO_2).

One critical future development of smart infusion systems will revolve around their full integration with computerized physician order entry (CPOE), pharmacy information systems, and bar coded medication administration (BCMA) platforms. With this integration, information technology could address many of the IV medication errors generated during medication ordering, documentation, dispensing, and monitoring.

Currently, smart infusion systems can capture and store alert data (i.e., continuous quality improvement, or CQI, data) that details when and where clinicians infuse medications at a dose or rate that exceeds established limits. Although the amount of specific information that CQI data can offer is somewhat limited, it does move us toward understanding frontline practices and the effectiveness and usability of our pumps' drug library databases.

Wireless Functionality to Improve Your System's IQ

Most vendors now offer wireless functionality with their smart infusion systems. Wireless functionality enables facilities to manage their systems from a remote location and, in some cases, track their pumps using RFID (radio frequency identification) technology. In addition, wireless functionality can aid facilities in streamlining their processes for uploading and downloading data to and from their pumps, leading to increased efficiency and, ultimately, improved patient safety.

When smart infusion systems first entered the market, their value-added capability centered on providing clinical decision support (CDS) at the bedside by way of alerts that fired when a clinician programmed an infusion that fell outside of predetermined limits. Although no one can argue that CDS is not an important feature in advancing the medication safety agenda, it has not produced the expected level of error prevention.[1,2] In fact, research shows clinicians frequently ignore CDS alerts,

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Without a doubt, **the added value** of wireless functionality – found in its ability to streamline data downloads and uploads and, thus, speed the improvement of clinical practices – **outweighs its cost**.

thereby rendering them useless.[3,4,5] That said, do not lose hope: Health information technology with CDS still has the potential to become a main source for medication error prevention; if programmers design it to work in an unobtrusive, timely, and comprehensible way, it could prove much more effective.[6]

Moreover, clinical decision support is not the only way in which smart infusion systems can accelerate the medication safety agenda. Namely, smart infusion systems capture and store data that can drive medication safety and process improvements. Prior to the advent of smart infusion systems with wireless capabilities, clinicians could only access this data by way of exhausting observational and retrospective chart-review methodologies or labor-intensive, manual data uploads and downloads.

To make CDS effective, we must make it meaningful to clinicians. To be taken seriously by busy clinicians, the alerts provided by our smart infusion systems must reflect the most current information available, while remaining consistent with policies, protocols, and evidence-based medicine. Wireless functionality allows the smart infusion system's drug library to reflect the most accurate medication information. For instance, new research has shown that the antibiotic meropenem produces the most effective results when infused over three hours, versus 30-minute infusions.[7] Using wireless functionality, a facility could update its smart infusion system's drug libraries almost immediately to reflect this clinical recommendation. Without wireless functionality, it could take weeks to find each pump and upload the new information into the drug library.

With near real-time retrieval of CQI data, wireless functionality can also allow you to determine whether or not a drug library update has been effective in encouraging clinicians to change practices. In viewing your CQI data, you can discern when alerts warned clinicians of out-of-limit infusions and if the clinicians adhered to the alert or chose, instead, to override it. If a certain alert is predominantly overridden, one of the following actions may be appropriate:

- The establishment of hard limits to prohibit potentially dangerous overrides
- Clinically appropriate drug library edits to decrease the number of unnecessary alerts given
- Protocol changes that more accurately reflect necessary and safe care for patients

It would be remiss to leave out another major advantage of near real-time data retrieval: In addition to improving patient safety, the ability to quickly give clinicians feedback regarding smart infusion system utilization methods maintains reverence among the end users of this technology. Without wireless technology, such feedback would be prohibitively delayed, making it less meaningful to end user clinicians. In fact, a recent study by Watson-Wyatt Worldwide demonstrated firms that invested in, implemented, and improved communication practices reported higher levels of employee engagement and greater financial returns.[8]

Tips From the Experts: IT's Input

The involvement of your facility's IT team is an indispensable part of the implementation of wireless functionality to support your smart infusion systems. Their expertise can allow your facility to achieve necessary objectives, which must be met in order to ensure the accuracy of pump data and, thereby, a reduction in medication errors. Keep the following considerations in mind when establishing your facility's wireless network.

WLAN Standards

The three major IEEE (Institute of Electrical and Electronics Engineers) WLAN (wireless local-area network) standards comprise 802.11b WiFi, 802.11a, and 802.11g, each of which has its advantages and disadvantages.

- **Transfer speed**: The 802.11b WiFi standard provides transfer speeds up to 11 megabits per second, whereas 802.11a provides transfer speeds up to 54 megabits per second. The new IEEE standard, 802.11g, also supports a transmission speed of 54 megabits per second
- **Range**: 802.11b WiFi has a range of up to 100 meters, indoors, and 300 meters, outdoors. 802.11a has a shorter range than WiFi, requiring more access points, and 802.11g has the same range as WiFi.
- **Interference**: WiFi and 802.11g suffer from interference from other 2.4 GHz devices like microwave ovens, but 802.11a does not, because it operates in the 5 GHz range.
- **Compatibility**: The 802.11a standard is not backward compatible with WiFi, requiring two different access devices to support both both types of standards in the same space. The 802.11g standard is backward compatible with both 802.11a and WiFi. (A backward compatible product is capable of interoperating with products designed for the product it has replaced.)

Network Coverage and Data Transfer

- Does wireless coverage extend to all patient rooms and care areas?
- Does your network provide data-quality (70dBm) signal strength in the required coverage areas?
- Does the system have sufficient bandwidth available to communicate drug library downloads and CQI data uploads?
- Has your facility assigned/reserved enough IP addresses to support all of your wireless devices, taking into account that an IP lease may extend for multiple days before it is released and made available to another device?
- Does your organization have sufficient hardware to support the number of pumps you plan to add? Some access points are limited as to the number of devices they can simultaneously connect.
- Do you have a significant amount of devices or data to transfer? If so, you can segregate your smart infusion system traffic from the rest of the network by creating a separate subnet (a range of IP addresses that can operate as an independent network).

- Do the pumps retain a constant connection to the access point, or do they disconnect and connect only when they need to transmit or receive data? This could affect the number of access points required by the system.

Network and Data Center Security

- Do the pumps support WEP (wired equivalent privacy) or WPA-PSK (WiFi-protected access preshared key encryption)? If your organization uses Cisco Systems hardware, does it support LEAP (lightweight, extensible authentication protocol)? Your organization should implement the highest level of security supported by both the pump and your network.
- Does your network and data center comply with HIPAA data-security standards?
- Is your drug library and CQI data appropriately secured against theft and misuse?

Support

- Do you have expert wireless support personnel? Supporting wireless devices and wireless troubleshooting can be a nightmare for a novice.
- As regulated medical devices, smart pumps require FDA 510(k) clearance. Therefore, hospital networking must enable vendor access to remotely monitor and effectively manage the system environment.
- What battery life does the device have? The more processing done, the longer the battery must last.

Unintended Consequences

The implementation of technology can trigger unintended consequences[9], so a comprehensive review of wireless smart infusion technology must reveal its known and potential consequences. Equipped with this knowledge, you can implement strategies to prevent unintended consequences from harming patients.

When a new data set (i.e., drug library) is pushed out wirelessly to the server, it becomes difficult, if not impossible, to quantify the length of time required for all of the smart infusion devices to upload it. Many times, the devices must be powered down and restarted before the new data set will transfer. In the ICU, infusion devices can treat the same patient for a great length of time, preventing the upload of new data to the device. Clinicians may use a second, updated pump to start new infusions for these patients, and the two pumps may have different and, perhaps, conflicting data sets with contradictory CDS recommendations. Such occurrences can cause mistrust in the technology and lead to a lack of compliance.

Along these lines, only a limited number of devices can transfer data to and from the server at one time. This not only increases the time it takes to upload a new data set to all of the devices, but it also creates lag time for the retrieval of CQI data from the devices, disrupting your consistent and timely data-sharing feedback loop and causing staff frustration. The sooner the staff can retrieve the data, the greater impact the data can have. This lag time can be decreased by making sure the appropriate number of server IP addresses are created both during the initial implementation and any time your organization purchases additional devices.

Unidentified wireless "dead" spots within the organization also contribute to lag time. Considerable testing before, during, and after implementation can help ensure timely upload of new data sets to all devices.

You may wish to enlist the help of your central supply team to check each smart infusion device for the appropriate data set before cycling it back out for use in patient care. When involving this team, it is critical to notify them when new data sets are sent to the server in order to ensure the process' success. Verifying data sets can add a significant amount of time to your central supply team's device recirculation process; however, your overall facility and, ultimately, your patients will benefit greatly from this extra step.

Photo courtesy of B. Braun Medical Inc.

Wireless functionality allows the smart infusion system's drug library to reflect **the most accurate medication information.**

Conclusion

Due to their patient safety benefits, smart infusion systems are clearly a preferred method for infusing IV medications. Although these systems alone can prevent medication errors, wireless functionality markedly improves their capability to improve patient safety. Without a doubt, the added value of wireless functionality – found in its ability to streamline data downloads and uploads and, thus, speed the improvement of clinical practices – outweighs its cost. With this in mind, it is important to seriously consider incorporating wireless functionality when implementing or upgrading smart infusion systems at your facility. ■

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WHERE TO FIND IT
Smart Pumps

www.findit.pppmag.com

Vendor	Reader Service Number
B. Braun Medical Inc.	90
Baxter Healthcare Corporation	91
Cardinal Health/Alaris	96
Hospira, Inc.	97
Sigma International	99
Smiths Medical	100

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