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SAFE PRACTICES in Patient Care

Helping to promote a culture of safety

Using Wireless Connectivity to Improve Patient Care and Workflow Processes

Janet Barber, MSN, RN, FAAFS

Computerized systems have revolutionized the healthcare industry, and wireless technology is the latest advance to promise an improvement in patient safety and a reduction in medical errors within the hospital setting. While new array of wireless devices opens even more and greater opportunities for improving clinical care, it can be a bit daunting for nurses trying to assimilate the new technology. In her article, Ms. Barber describes the various types of wireless technology and demonstrates their potential for improving nursing-care processes.

In a roundtable discussion, we brought together several nursing experts who have hands-on experience with the introduction of wireless technology in the healthcare setting. From our panelists we wanted to know: Where are we today? Is our expectation of the technology realistic? How will wireless point-of-care systems change the nursing environment? How will these changes affect patients? Will this technology reduce medical errors?

With today's challenging work environment that includes acutely ill patients, care complexity, and nursing shortages, hospitals are intently looking for ways to increase caregiver efficiency and streamline patient throughput while ensuring high-quality care and safety. This is a tall order given the financial restraints on most hospitals, but there are many technological innovations that promise to provide some solutions to these pervasive problems in the clinical environment.

An obvious solution is to continuously provide the nurse with connections to data, records, and people that can make the right things happen efficiently, expediently, and with flawless precision that maximizes positive outcomes. During the last decade, the rapid growth of computers and other digital interfaces at the point of care has opened a realm of potential solutions for improving operational efficiency, benefiting nurses, patients, and the hospital's bottom line. Ready, rapid connectivity through wired and wireless devices offers many advantages to frustrated nurses who by now have learned to survive in their stressful and complex environment by becoming geniuses at multi-tasking.

The world of hard-wired computers and medical devices has contributed greatly to clinical safety and efficiency, and now the new array of wireless devices opens even more and greater opportunities for improving clinical care and ensuring better outcomes for patients. This article is designed to introduce various types of wireless technology and to demonstrate their potential for improving nursing-care processes.

Understanding wireless technology

Certain medical devices such as life-support equipment and critical monitors must be directly wire-connected to a power source with an emergency power backup. However, the remainder of bedside devices can utilize wireless connections. A bedside portal permits the nurse access to third-party applications and information, with several key benefits to be derived. There is easy access to the pharmacy database and to laboratory/radiology results. The status of in-room equipment can be ascertained, and operational information about various devices can be easily retrieved. Information from medical records, the physicians' phone directory, or the policy/procedure manual is readily available, along with many other sources of information. The status of ordered equipment, supplies, diet trays, or referral services is at the nurse's fingertips. Resources of the World Wide Web are just a mouse-click away.

The wireless world has vast potential, and nurses need to be knowledgeable with what the major commercial technologies have to offer at the bedside and in determining what applications would be most valuable in a particular practice arena. Let us now look at the different wireless applications that are in current use in healthcare facilities: telemetry, WiFi, RFID, Bluetooth®, and Global Positioning Systems.

Telemetry and WiFi

Medical telemetry has been available for several decades (over 40 years) and has been widely used to send EKGs from ambulances to hospitals, from one hospital location to another, or from a patient's phone to a physician's office or telemetry station. Telemetry can transmit data such as oxygen saturation, blood pressure, respirations, and temperature. These transmissions of data are made possible by radiofrequencies dedicated to medical purposes. They operate within low-power bands: 608–614 MHz, 1395–1400 MHz, and 1429–1432 MHz. The FCC has restricted these bands to short, non-continuous messaging due to bandwidth limitations and interference issues.[1]

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SAFE PRACTICES**FORUM**

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This issue's commentary:
DEHP Exposure in Infants
by M.T. Verklan, RNC, PhD

Supported by an educational grant from Kendall, a business unit of Tyco Healthcare Group LP

Roundtable Discussion

Improving Patient Safety With Wireless Point-of-Care Technology: *Where are we today?*

Moderator:
Janet Barber RN, MSN

Panelists:
June Craig, RN, PhD
Karen Hatfield RN,
Linda Kobokovich, RN, PhD
Joe Naranjo, MSN, CNAA, RN
Diana Russell, RN, MSN
Coy Smith RN, ND

Computerized systems have revolutionized the healthcare industry, and wireless technology is the latest advance to promise an improvement in patient safety and a reduction in medical errors within the hospital setting.

Where are we today? Are these expectations realistic? How will wireless point-of-care systems and stand-alone devices change the nursing environment? How will these changes affect patients? What impact will wireless technology have in the healthcare workplace? Can this technology help to reduce medical errors?

In our roundtable discussion, we brought together several experts who have hands-on experience with the introduction of wireless technology in the healthcare setting. Coy Smith, Karen Hatfield, Diana Russell, Joe Naranjo, June Craig, and Linda Kobokovitch have implemented or are in the process of implementing wireless point-of-care systems and devices at hospitals and healthcare facilities across the nation. Their experience differs in some ways but shares common goals and achievements. We are fortunate that they are willing to share their practical experience with us.

Barber: ***From 48,000 to 98,000 patients die from medical errors in hospitals annually. To address this problem, JCAHO has recommended the incorporation of technology to reduce errors. What wireless technology has been implemented at your hospital? If applicable to your technology, have you seen any reduction in medical errors?***

Smith: Our wireless implementation is in a multi-year, stage-by-stage process. Our plan is to have a hardwired, radio-frequency network in all clinical areas. Our current clinical documentation system works in real-time and has some wireless nodes for hospital registration at bedside and bedside vital-sign collection by nurse aides.

We were fortunate to get a state grant for a robotic system that prevents pharmaceutical dispensing errors. All of our medications are barcoded. The robot reads the barcode and matches it with what the patient needs, finds it, puts it in a drawer, then the medication goes out to the nurses. We've eliminated about 10-11% of dispensing errors. However, most medication errors occur during nursing administration. Our next step is to implement a portable, wireless hand-held barcode reader for nurses that will interact with the automated barcoded pharmacy system. Physicians will also have access to this information through wireless devices or kiosks. Even patients will be barcoded, so that, eventually, the wireless device will scan the patient, nurse and medication, so we will know who is administering what medication to whom at what time. Once the medication is scanned, administration will be noted automatically, so the nurse no longer has to enter that information manually.

We're also seeing a whole new generation of bedside wireless devices, such as bed exit alarms, IV pumps, BP cuffs, and more. These devices transmit data to eliminate manual entry, get rid of clumsy wires, and enhance patient mobility. These devices eliminate the need to write things down on a scrap of paper, walk over to a computer terminal and enter information manually. Often, nurses can't get to the computer terminal right away, so there's a delay in getting that information into the system. They tend to batch enter data, and there is a danger of inputting errors. Wireless devices eliminate that delay and those errors.

Russell: We have a wireless telephone call system, wireless vital-sign documentation, and wireless charting on wireless devices for doctors, nurses, social workers, and caregivers from different disciplines. We have CPOE and a computer-on-wheels system (COWS) in all clinical areas for staff documentation of clinical information.

We were first in the world to implement CPOE in the 1960s, so we achieved a reduction in medical transcription errors some time ago. In the last few years, we have implemented an electronic order verification system and a more timely order review by the pharmacist, eliminating medical errors. We have also introduced a wireless IV pump, which has reduced infusion errors.

Hatfield: We have a wireless backbone throughout our hospital facilities. Back in the 1990s, we started with a wireless infrastructure, primarily putting laptops on carts to encourage physicians to enter their own data.

Once we adopt wireless barcoding technology for the administration of medication, we expect to see big reductions in medical errors. Today, typically what happens is that the doctor handwrites the prescription order, then a secretary or technician transcribes that order into the computer. There's an opportunity for transcription errors. We're trying to close that loop by pursuing wireless computerized physician order entry (CPOE). Nurses at our facilities use wireless technology for clinical documentation, but that has not reduced medical errors as such.

Naranjo: We have a wireless point-of-care documentation system in the emergency department and cardiac telemetry throughout the hospital. With telemetry, the cardiac signs of patients anywhere in the hospital can be monitored from a central location. We also have a wireless telephone system that frees the nurse to move about in her environment, yet have instant communication with other caregivers, patients, and doctors. We do not, as yet, have an electronic documentation system, but a pilot program is starting up at our sister hospital.

Kobokovich: Before we had wireless telemetry, any patient with a transitory cardiac problem was transferred to the cardiac unit. Now, a technician monitors these patients remotely from the cardiac unit. The patient receives care from nurses whose skills are more in line with the patient's illness, and we didn't have to teach every nurse how to monitor cardiac rhythms.

We use wireless point-of-care devices, including electronic fetal monitors that allow patients to

ambulate while in labor. These devices allow us to meet best practice standards, while giving the patients that extra amount of freedom. To detect GERD, patients can swallow a capsule that adheres to the esophagus and monitors pH remotely for 4 days by sending signals to a wireless device worn by the patient. After 4 days, the capsule disintegrates. This device removes the risk of a more invasive procedure and gives real-time data that is useful to physicians. We also use wireless glucose monitors for patients with diabetes.

We have an electronic medical record in the ambulatory setting that can be accessed by wireless technology. It captures clinical information and tracks the patient's medications and allergies. Our care managers, nurses, and physicians can go to the patient's room and check laboratory results wirelessly, while they are sitting at the patient's bedside. We have made work easier for that group and decreased medical errors, because you can verify information at the bedside.

Barber: ***Some studies have reported that about 25% of nursing time involves non-patient care activities, primarily charting, paperwork, etc. How has your facility used wireless technology to reduce the non-patient care functions? Have you seen a decrease since implementation?***

Hatfield: Our nurses use wireless technology at the bedside for clinical documentation, but what you typically see is that they will pull the wireless cart into the hallway, where it is quiet, and work from there. Wireless has decreased our documentation time somewhat, and it has given us the ability to move the nurse away from time behind a desk, not looking busy to the patient's family members, to time at the bedside, where they are nearer to the patient. Documentation and referencing materials are in closer proximity to the point of care.

Kobokovich: Bedside vital-sign monitoring is tremendously helpful from a cost and consistency-of-equipment perspective, because we don't have to put a monitor in every pediatric room. It gets rid of wires around children. Historically, wires were easily lost and expensive to replace.

Devices like the wireless glucose monitor saves documentation time. It also increases the likelihood of correct identification of patient and sample. Wireless telemetry has eliminated a large amount of documentation, because the cardiac technician instead of nurses now collects all the information on the units.

Russell: With wireless technology, we've eliminated the need to transcribe vital signs. They are immediately documented in real-time in the electronic record. This has eliminated transcription errors, and we've improved the timeliness of data availability to other caregivers. Before, it would take several hours before all vital signs were transcribed into the computer. Now, if the patient has an elevated temperature, it comes to the immediate attention of the nurse on duty.

Bedside vital-sign monitoring is tremendously helpful from a cost and consistency-of-equipment perspective, because we don't have to put a monitor in every pediatric room.

Linda Kobokovich

The wireless phone system has eliminated the time delays in finding caregivers. Caregivers can contact other caregivers immediately. They don't need to find a land-line and call a number. They just push a button and speak into the wireless device. Our response time is much faster, because we've eliminated steps in the communication process. If the nurse is at the bedside and a patient asks for medication, the nurse can immediately contact a doctor. It also has eliminated the time consuming centralized search for staff to take an incoming call.

Barber: ***Implementing a new technology like wireless, point-of-care technology can be expensive. Did your facility conduct a cost-benefit analysis before implementation? What cost savings have you realized?***

Hatfield: We did a cost-benefit analysis prior to implementation of our core electronic health record (EHR) program. Our original software was put in place in 1983, and that system has gradually been expanded over time. With this product, early on, we recognized a significant cost savings. We feel that, in many ways, the system has paid for itself many times over in terms of time and personnel savings. With wireless, the biggest reductions come in medical errors and staff time, not necessarily in cost savings. We've been blessed in that our administration has really wanted us to be on the cutting edge and supported our transition to wireless technology. Wireless has definitely improved patient safety and satisfaction.

Smith: We've been able to get technology grants to cover the cost of some wireless systems, but I have committed to some reduction in personnel costs. Our nursing staff accumulates about 1500 hours in overtime every two weeks due to documentation after the end of shift, and we hope to cut those overtime hours significantly once the wireless system is in place. We also anticipate that nurses will be able to spend more time with patients.

Russell: We didn't. The communication technology that we were using was outmoded and difficult to use. When we found a better technology, we felt that it would improve care. We knew that the technology would not replace caregivers. It wouldn't take those dollars out of the equation, but we knew that it would improve the timeliness of care. We put it into one unit on a trial basis, and every unit wanted it after that.

We also didn't do a cost-benefit analysis for the wireless vital-sign system. We felt that it would improve communication and therefore improve care, but it wasn't going to eliminate any costs. We believed that it would increase physician satisfaction, because physicians would have that information when they needed it, and our physicians really like it very much.

Naranjo: No. If you save time through wireless technology, that in essence, saves dollars.

Kobokovich: Bedside vital signs monitoring via wireless technology is tremendously helpful from a cost and consistency-of-equipment perspective, because we don't have to put a monitor in every room.

We did an extensive cost-benefit analysis for wireless telemetry, and it proved to be a money-saving venture. It has exceeded our cost-savings expectations.

Barber: ***In traditional point-of-care documentation, a lag time exists from charting to analysis to intervention. Wireless captures information continuously. How has this changed your clinical decision-making?***

Hatfield: With wireless, nurses are faster at documenting information, and healthcare professionals can access that information at any point of care, wireless or not, throughout the hospital. It's easier to find out the patient's clinical history to aid decision-making. We can tell whether the patient has had previous surgery, has a food allergy, needs special equipment, and so on. This capability saves considerable time, since nurses do not have to document the same information over and over

in different areas of the hospital.

Smith: Wireless devices capture information immediately, with no need for the nurse to enter it manually into a computer terminal. The physician has immediate access to those vital signs and has the ability to make clinical decisions sooner. The better we consolidate the physician's world onto one platform, the sooner clinical decisions can be made.

Russell: Wireless has deceased steps and improved the timeliness of decision-making. We aren't making different decisions, but we have eliminated steps in the communication process and thereby enhanced our care.

Craig: After a patient is quick admitted in emergency, they go to triage, where a nurse records their vital signs with a wireless device. As data accumulates in this process, the decision-making of the people who follow that data is improved, because they can access the relevant clinical data at every single workstation. Previously, physicians would assess patients as if no one else had seen them. The cumulative nature of online, real-time documentation in a wireless world would seem to improve clinical decision-making, but I have no way to prove that.

Kobokovich: Wireless telemetry has changed our clinical decision-making and modified our response to different cardiac rhythms. The electronic fetal monitor has also affected our management practices.

Barber: ***Has your facility been able to eliminate charts, paper, etc., with Wireless technology?***

Hatfield: We have a wonderful system that allows caregivers to retrieve data from anywhere, appropriate to their role in patient care. However, we've been unsuccessful in trying to get away from paper for the simple reason that we cannot guarantee that the system is up 100% of the time. We have about 20 minutes of downtime every night. That's a long time to be paperless. If a patient codes, you're in trouble. Until we can guarantee 100% up time, we'll still rely on paper.

Russell: We're working in that direction. We do not yet have a PACS system. Our older charts are electronic. When patients are discharged, their charts become electronic, but while they are here, they still have a paper chart for now.

Kobokovich: On the ambulatory side, we've almost totally eliminated charts and paper. We haven't seen that same degree of paper elimination on the in-patient side.

Barber: ***Change is often difficult, especially when it involves sophisticated technology. What training programs have you created to help your staff to adjust to the wireless environment?***

Hatfield: We're not a teaching hospital, and we have to work diligently with our physicians to get them to use the wireless system. We've had some trouble getting them to participate and must continuously dangle carrots to bring them up to speed.

With our nurses, we've done some extensive hand holding. When wireless was introduced, it was for physician use only. Nurses were told not to use it. Now, we have close to 300 wireless laptops on my nursing unit alone. We had to overcome a built-in reluctance to use the technology, which we had created.

Some nurses feel uncomfortable documenting vital signs in the patient's room and prefer to use the units in the hallway. We had to re-examine the interface, because some nurses were more comfortable with a mouse than finger-pointing access. We looked at cart height and other factors. We had to ensure that there were no signal blackout areas in the wireless network. Battery life was also an issue, because nurses forgot to plug in their laptops for battery recharging. We also had to teach them Windows.

Wireless has simplified some processes, but it requires a higher level of technical expertise. Some senior nurses love it, but others tend to resist more than younger nurses who are schooled with technology. We lost some nurses who didn't want to adapt.

Smith: Implementation is an important, time-consuming operation that you need to cost out. Everyone at our institution goes through a hands-on training program. We also train people who act as troubleshooters. One is present on every shift, in every unit. So, we have people who are minimally trained and a small core of super-users.

Newer nursing graduates are more comfortable with wireless and can't imagine using a pencil and paper. Adaption takes a bit longer for senior staffers, but once they develop good computer skills, they do well. We start them at square zero with basic keyboarding classes.

Russell: With the wireless telephone system, we had to do additional training in voice recognition. Our staff is pretty computer savvy, but a lot of new wireless technology works on Windows, so they've had to train them in that format. Our system has an intuitive interface, so we didn't need to do an excessive amount of training. Our goal is to complete all documentation at bedside. We haven't experienced any resistance, probably because we've had the system for so long, and Wireless only makes it easier.

Craig: When we implemented the emergency-department wireless system, the vendor supplied us with computer-based training CDs, which were given to every single person who touched with system. The nurses needed to pass a competency test before they could work in the unit. We didn't lose any nurses, not a one. You always have early adopters and hand-wringers. We simplified the connectivity and sign-on processes to eliminate time delays in getting wireless equipment up and running, and that made a real difference in terms of reducing the frustrations that our nurses had in working with these systems.

Kobokovich: For nurses who are used to hard-wired monitors, wireless devices are not significantly different. It's not a big change. Wireless telemetry was a big change, and we managed it by organizing a local program that focused on the aspects of cardiac telemetry that nurses needed to know. We did some initial training on how to get the right resources there quickly if the patient had an acute episode. Some wireless technology comes with on-board tutorials, which changes the way that we do education.

We have senior nurses who want help but aren't always crazy about using technology to get it. They don't see these tools as ways to simplify their environment. Younger nurses want the technology and want us to be doing more.

Barber: ***Has wireless technology simplified your clinical environment?***

Hatfield: Yes, because we've been able to decentralize. Traditionally, the nursing station was always the central-access point. Now, it's at the bedside, where it really should be. As we continue to travel down this road, more things will be done at the patient level.

Smith: I've always believed that if you're going to implement technology, it has to take the nurse less time. Our current model of clinical documentation takes longer and that's why we're upgrading to wireless. My goal is for clinical documentation to take 50% less time.

Russell: Wireless has eliminated the need to double-chart anything, so we have a more timely documentation process that's immediately available to multiple caregivers. If you have a paper chart, only one person can read it at a time. When you have an electronic medical record, multiple users can see that chart at one time. With wireless, that record can be immediately updated with the most recent data, so all our decisions are more timely.

Naranjo: Wireless gives us immediate access to immediate information. It saves a tremendous amount of time. It gives us the data we need at our fingertips. In the emergency department, the implementation of wireless technology has improved workflow in a very busy environment.

Kobokovich: By using wireless technology, we can get away with using less equipment. Wireless moves from room to room, so the nurse only has one type of monitor to deal with, and he or she can use that monitor more consistently. The nurse understands the technology more easily and doesn't have to know how to work two to three different types of monitors.

June Craig, RN, PhD, has extensive experience in diverse aspects of the healthcare industry from clinical nurse to nurse executive. She has over 15 years of experience in managing clinical analysts and engineers and has been a Clinical Informatics leader since the beginning of clinical computing.

Linda Kobokovich, RN, PhD, has been a nurse leader for over 10 years. She has been actively involved with bringing innovation to the facilities in which she has worked. She has published several articles in peer-reviewed journals and presented over 100 papers at local and national meetings.

Joe Naranjo, RN, MSN, CNAA, has had progressive responsibility for telemetry centers and the implementation of wireless technology in neuroscience, cardiovascular, orthopedic and oncology centers for the past 9 years. He has lectured on healthcare management systems and is on the advisory board of the "Patient Room of the Future."

Diana Russell, MSN, RN, CNAA, BC, has assumed progressively more responsible positions in the field of nursing administration over the past 18 years. She has been an nurse executive for over 10 years and has been involved in the design, implementation and evaluation of several programs to improve the quality of care and efficient utilization of resources, in which wireless technology is essential.

Coy Smith, ND, RN, has been a healthcare executive for over 10 years. He has been instrumental in implementing new technology to improve nursing workflow and patient safety and care. He has lectured on this topic at SUNY. As past-president, Coy is an active member of American College of Healthcare executive.

Karen Hatfield, RN, has over 10 years of experience in information systems and applications in nursing practice. She is currently responsible for the management of nursing staff in the design and implementation of clinical information systems at North Mississippi Medical Center in Missouri. She has also presented this topic at various meetings

Using Wireless Connectivity to Improve Patient Care and Workflow Processes — Continued

Because medical telemetry is limited to the transmission of short, non-continuous data, its application is not ideal for all medical purposes. WiFi (wireless fidelity) is a more advanced radio technology (based on IEEE standard 802.11) capable of transmitting more complex data and transmitting it continuously. WiFi uses a broadcast power band centered at 2.4 GHz that is capable of handling complex data at a much higher rate.

Wireless local area networks

Wireless local area networks (WLANs) use WiFi and are the system of choice for hospitals that want to move to a new age in connectivity. They have been vital components in the arsenal of approaches to combat medical errors, especially in drug delivery systems. With hand-held computer connections to infusion pumps or medication dispensing units, the nurse can verify patient information, track drug delivery in real time, and view any clinical alerts or other actions required for a particular agent. Manufacturers of such technological adjuncts envision more efficiency in care as well as improved verification processes that contribute to patient safety at the point of care.

WLANs enable voice-controlled communications throughout a WiFi-networked building or location. A server or base station sets up calls between badges of various individuals, effecting instant conversations among personnel (such as an emergency-response team) who may be in any one of several locations at any given time. Calls and data exchanges are secured, and patient privacy is assured within the system. The WLAN can be linked with the facility's PBX system, too, permitting prompt connectivity to individuals outside the WLAN. Since this type of communication uses the ISM (Industrial Scientific Medical) wireless band, it does not affect any other electronic equipment within the facility.[2]

Bluetooth

Bluetooth (IEEE 802.15) technology is named after the king who united all of Denmark. It provides wireless local connections between devices and peripherals such as PCs, cell phones, and Internet access points. Since battery power is precious and limited, the applications use little power, thus limiting transmission range. Several Bluetooth-compatible devices can be linked within a small radius (about 30 feet). Bluetooth 1.0, the first version, permitted the user to bind or interface with a single device at a time; however, today's version (Bluetooth 1.1) permits communication with up to 8 devices. Bluetooth can be used with embedded applications to send serial data to another device for storage and retrieval. For example, a Bluetooth-enabled device, such as a thermometer, can transmit readings to a nurse's PDA or a laptop located in the patient's room.

Radio frequency identification

Radio frequency identification (RFID) is a wireless system that relies on information-filled "tags"—silicone chips with antennas. Tags can be strapped on wrists, worn like badges, or attached to equipment and supplies. RFID offers amazing ability to locate and track people, equipment, supplies, and processes. The technology is superior to traditional barcoding because the information can be read through and around the human body, clothing, bed linens, and non-metallic materials. RFID-enabled processes are ideal for positive identification of patients and matching this information with the right drugs and the right equipment. RFID can be useful in point-of-care testing, quality assurance, inventory control procedures, patient billing, and other processes, making it an extremely high-value proposition within the hospital.

Global positioning systems

Global positioning systems (GPS) are satellite-linked devices. They have been employed in some facilities to support flow of information and to track patients during interhospital transfers. A GPS can communicate information including dispatch and arrival times, as well as a patient's clinical status, thus reducing on-hold and waiting time for providers. The University of Maryland Medical Center has designed a system with vehicle identification, custom software, and user interfaces that permit the collection, processing, and delivery of vital information to the receiving facility.[4] In addition to a moving map display and alphanumeric paging capabilities, the system incorporates wireless personal digital assistants (PDAs) for nurses and physicians to retrieve information from the server. The capability to follow a patient's progress from dispatch to arrival removes the guesswork about such factors as when the emergency team should be poised for action or when the operating room or special-procedure staff should be ready to begin their case. Similar systems using other wireless devices accomplish this type of real-time tracking for in-house patients. Recovery room nurses know precisely when the surgery is over and they can be ready to receive a patient, or the ICU nurses can have the room ready for an imminent transfer from the recovery room or emergency department. This type of "real-time" information prevents downtime while staff merely waits, and it prevents surprise arrivals at the unit when staff are not yet prepared to receive the patient.

Wireless technology at point of care

It is now possible to reap the benefits of integrating information coming from a wide array of equipment and making clinical decisions based on those data. For example, various

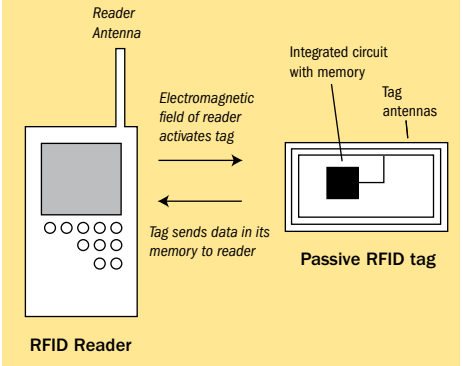
physiological monitors, beds, infusion pumps, and point-of-care (POC) testing devices can share data used for clinical decisions. In some cases, decisions can be made by proxy, permitting the nurse to engage in other work; the equipment collects the information, analyzes it, automatically initiates actions, and precisely documents the events in real time. Let's look at an example: A post-surgical neurology patient in the ICU is increasingly agitated. The bed's mattress senses his restlessness and validates its findings with the cerebral function monitor. In the meantime, vital signs and oxygen saturation levels are quickly checked to determine if it is appropriate to accelerate the administration of sedation and analgesia via infusion pumps. Within seconds, the medication is being delivered into the IV line, the monitors confirm that cerebral functions and vital signs are within acceptable parameters, the event is recorded for clinicians, and appropriate notifications are made to the pharmacy. In response the pharmacy delivers more of the drug to the floor earlier than previously scheduled to compensate for the additional administration required.

These automatic systems provide rapid assessments and interventions that effect positive patient outcomes. The typical delays that occur between problem identification and definitive actions are virtually eliminated, and physicians are reassured that, when problems occur, they are promptly addressed.

Advantages and safety of wireless technology

The upgrading of hospitals' IT (information technology) systems can pave the way for addressing JCAHO's safety agenda and offer many opportunities for elevating quality of care. The advisory board outlined 11 safety-related clinical practices that are dependent upon IT: bar-coded medication administration, smart IV pumps, real-time lab analysis, pharmacy system integration, remote ICU monitoring, and automated reminders.[5] Wireless technology can enable hospitals to address major safety concerns while enhancing personnel efficiency in the process.

Fig. 1 Process flow in a radiofrequency identification system using positive tags.



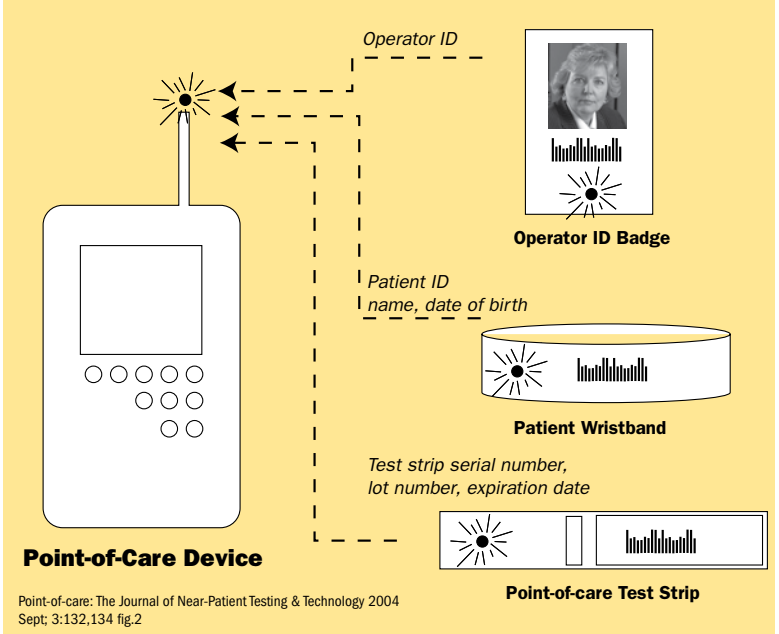
Point-of-care: The Journal of Near-Patient Testing & Technology 2004 Sept; 3:132,134 fig.1

"Plug and play" integration models emphasize the orchestration of people, processes, and technologies.[3] With a hands-free wireless device for messaging, alarm notifications are transmitted to the mobile caregiver and can be managed remotely as well, permitting the caregiver to proceed with work, uninterrupted except by a voice message. Prompt notification of critical alarm scenarios improves the safety net for patients, prompting the caregiver to manage alarms at the moment they are generated at the primary source. The wireless phone-like messaging device can be interfaced with many bedside devices, making it extremely valuable for bringing together disparate equipment within the care arena.

Mobility and flexibility

Remote access to bedside monitors and other equipment is often achieved via hard-wired systems that are linked to a remote area such as a nurses' station or telemetry monitoring room. When a patient is moved, hard-wired monitors and other devices must be disconnected and reconnected. Wireless devices, however, manage all connections automatically, and the caregiver does not need to disconnect or reconnect them, making them truly mobile. The telephone, perhaps the most-frequently used communication device, becomes far more useful when it is not tethered to a wall or desk; it becomes even more useful when it can be operated hands-free, permitting the nurse to continue care while placing or receiving calls or pages. Wireless applications can offer this same convenience to medical devices.

Figure 2. Point of care testing in a radiofrequency enabled environment.



Point-of-care: The Journal of Near-Patient Testing & Technology 2004 Sept; 3:132,134 fig.2

Increased operational efficiency for throughput

How often have you waited for one bit of data, such as a lab value or X-ray result, in order to proceed with therapies or initiate a transfer to another unit? How often have you waited for input of physicians that required sending, transferring, or relaying messages by voicemail or other messaging systems? Wireless devices allow nurses to monitor vital functions, immediately acquire laboratory results, and to retrieve and transmit information throughout the facility without leaving the bedside. This has greatly reduced delays in patient-care decisions that influence throughput.

Delays in healthcare access and delivery are pervasive. Waiting times negatively impact full utilization of hospital resources and serve to frustrate patients as well as clinical staff. Having the capability to check on the status of a patient, to obtain required data for throughput decisions, and to learn the whereabouts of patients, equipment, drugs, and medical supplies, as well as caregivers, is vital in today's hospital. With wireless interfaces, such data is a mouse-click away. Simple applications—such as notifying a nurse that an assigned patient has returned to the unit following a procedure, or ensuring that a dietary tray is enroute promptly after blood-glucose level has been determined and insulin administration has taken place—would assist greatly in reducing adverse events as well as staff and patient frustrations.

Wireless connectivity can promptly provide the required data and offer clinicians the means to communicate it throughout the network to effect appropriate nursing care. A central database server can maintain records for all users and can be accessed at any time from any place by a radio-enabled PDA or laptop computer. This type of system ensures the most current patient information and provides the capability for it to be updated. In some cases, equipment may have an embedded device that incorporates both a processor and software; a PC can be used to download data from the embedded device for storage and access at a later time.[1]

Point-of-care testing support

Nurses readily appreciate that prompt access to laboratory results is vital to patient care

decision-making and throughput. Highly efficient POC (point-of-care) testing programs can collect, store, evaluate, identify, correct, update, suggest, record, and report results, holding any questionable information for manual intervention and relaying of concerns to appropriate individuals or departments.[6]

Incorrect blood specimen handling can cause errors such as hemolysis, erythrocyte settling, poor mixing, microclots, or sample degradation, requiring a repeated blood draw. Other errors—such as critical values not flagged, results reported inaccurately, incomplete patient data on the order slip, time of sampling not recorded, reports not directed to the caregiver responsible for the patient—occur after the test is completed.[7] A well-designed POC testing regimen can do much to eliminate such errors.

When POC testing occurs in any clinical setting, response time and accuracy are vital elements. A radiofrequency reader can gather information from identification tags for all networked objects, even caregivers. When used with test strips/cartridges, operator identification badges, patient wristbands, and quality control, it can support virtual automatic documentation with an error rate approaching zero.[8]

Installation ease

The introduction of wired systems is frequently limited to new constructions, or it requires extensive architectural planning to install cables, route wires, and provide suitable receptacles. Wireless networks can be added to any facility without any structural modifications, and installations are possible with little or no disruption in everyday patient activities.

Security

The data in wireless applications must be protected from unauthorized access and hackers. Several wireless applications offer security options. For instance, devices intended to be linked are given the same ID numbers; thus illegitimate entry from devices with non-identical numbers is blocked. A second security process requires that user access be approved for a specified set of devices, similar to using a password or PIN (personal identification number) for computer access. Data encryption can also be used in some sensitive applications. The privacy of patients and data can be reliably protected in wireless devices, and thus security concerns should be allayed.

Summary

Wireless connectivity via LANs is replacing earlier systems of communication that were cumbersome and inefficient for mobile caregivers. Pagers, cell phones, voice mail, e-mail, radios, faxes, text messaging, and overhead paging are being replaced with a simple handheld messaging device worn by the caregiver. This phone-like instrument enables real-time connectivity and gets the right information to the right individual almost instantaneously, typically with hands-free operation. Such telephone technology linked with inherent nurse communications systems can improve patient throughput and increase staff efficiency. Manufacturers are striving to link their equipment and medical devices within LANs' open architecture to deliver safe, expedient care that will contribute to a positive patient outcome.

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This continuing education activity was approved by the Vermont State Nurses Association, Inc., an accredited approver by the American Nurses Credentialing Center's Commission on Accreditation (ANCC).

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1. Identify the contributions of wireless technology in relation to increased nursing efficiency, improved throughput, and patient safety.
2. List 3 unique benefits of "plug and play" integration for routine hospital communications
3. Describe how RFID-enabled environments can facilitate point-of-care testing programs.
4. Explain how the use of wireless technology can reduce medication errors.
5. List 3 considerations in planning for implementation of wireless technologies.
6. List 3 advantages of using electronic medical record

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1. All of the following statements about wireless technology are true except:

a. wireless connections are the optimal choices for life-support equipment such as ventilators and defibrillators.
b. wireless local area networks (WLANS) provide considerable versatility for in-room connectivity of multiple devices.
c. bluetooth, used in conjunction with embedded applications can enable the sending of serial data from one device to another.
d. wiFi's advantage over basic telemetric devices is its higher transmission rate.

2. Which of these agencies regulates the transmission of medical telemetry?

a. Food and Drug Administration (FDA)
b. Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
c. Federal Communications Commission (FCC)
d. none of the above

3. What item would enable nurses to connect to a wireless local area network?

a. telephone
b. computer
c. bar-code reader
d. global positioning satellite (GPS) module

4. Which of the following nursing actions could be facilitated by a "plug and play" device?

a. alarm notification to caregiver
b. paging for a physician
c. sending message to laboratory
d. all of the above

5. One of the features of Bluetooth technology that makes it highly desirable for medical equipment connections is that it:

a. relies on satellite communications and therefore is not affected by cellphones or radio intereference
b. can span huge areas such as the entire hospital
c. is a dedicated source of information that requires no peripherals for most applications
d. uses little power, thus conserving battery life

6. A global positioning system (GPS) would be most useful to:

a. track medication deliveries from the pharmacy to the ICU
b. find lost equipment in other parts of the hospital
c. estimate the time of an OR case arriving from another facility
d. locate physicians and other personnel within the hospital and immediate surroundings

7. Which of the following is the major advantage of wireless systems that track hospital throughput?

a. staff efficiency can be accurately measured for benchmarking activities
b. tracking improves revenue by permitting all charges to be logged in "real-time"
c. tracking provides precise data retrieval when needed by risk management
d. staff are promptly alerted when patients are moving from one location to another

8. The security of wireless systems is assured by processes that:

a. assure authorization and authentication for users
b. use "wire-tap" technology to police the system usage
c. link the connections directly to the FCC's continuous surveillance hardware
d. use sophisticated barcodes on all equipment and the caregiver's badge

9. Which of the following laboratory test problems can be reduced or eliminated by radio-frequency enabled technology for point-of-care testing?

a. Sample degradation from improper handling of blood
b. Mismatched patient or sample identification or lost specimen
c. Failure to report and notify staff when critical values are detected
d. All of the above

10. What is one notable limitation of wireless technology?

a. It can only be installed at the time of building construction or remodeling
b. All networked equipment must be purchased from a single manufacturer to ensure compatibility
c. The local area networks (LANS) are "crowded" with telemetry and interference may impair operations
d. Certain life-support devices and critical equipment must be wire-connected for reliabilitiy

11 Which of the following wireless technologies can reduce non-patient care activities by reducing documentation time?

a. wireless glucose monitors
b. wireless telemetry
c. bedside vital signs monitors
d. all of the above

12. What measurement can be used to calculate cost savings by implementing new wireless technology?

a. timeliness of care
b. decrease in overtime costs
c. reduction in medical errors
d. increase in physician satisfaction

13. How does wireless technology change clinical decision making?

a. eliminates the need to double chart anything
b. eliminates steps in the communication process
c. devices capture information immediately without need for manual input
d. immediate access to vital signs and clinical data improves the decision-making

14. All of the following statements about implementing wireless technology are true except?

a. wireless technology has simplified some processes, but it requires a higher level of technical expertise
b. all staff members give up using pencil and paper and readily accept using wireless technology
c. implementation is an important time-consuming operation that you need to cost out
d. battery life can be an issue as the staff need to plug in their laptops for recharging

Participant's Evaluation

What is the highest degree you have earned (circle one) ? 1. Diploma 2. Associate 3. Bachelor's 4. Master's 5. Doctorate

Indicate to what degree you met the objectives for this program: Using 1 = Strongly disagree to 6 = strongly agree rating scale, please circle the number that best reflects the extent of your agreement to each statement.

	Strongly Disagree					Strongly Agree
1. Identify the contributions of wireless technology in relation to increased nursing efficiency, improved throughput, and patient safety.	1	2	3	4	5	6
2. List 3 unique benefits of "plug and play" integration for routine hospital communications	1	2	3	4	5	6
3. Describe how RFID-enabled environments can facilitate point-of-care testing programs.	1	2	3	4	5	6
4. Explain how the use of wireless technology can reduce medication errors.	1	2	3	4	5	6
5. List 3 considerations in planning for implementation of wireless technologies.	1	2	3	4	5	6
6. List 3 advantages of using electronic medical record	1	2	3	4	5	6

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Mark your answers with an X in the box next to the correct answer

	A	B	C	D		A	B	C	D
1	☐	☐	☐	☐	9	☐	☐	☐	☐
2	☐	☐	☐	☐	10	☐	☐	☐	☐
3	☐	☐	☐	☐	11	☐	☐	☐	☐
4	☐	☐	☐	☐	12	☐	☐	☐	☐
5	☐	☐	☐	☐	13	☐	☐	☐	☐
6	☐	☐	☐	☐	14	☐	☐	☐	☐
7	☐	☐	☐	☐	15	☐	☐	☐	☐
8	☐	☐	☐	☐	16	☐	☐	☐	☐

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