

Should Your Hospital Implement Wireless Solutions?

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Over the past several years, consumers and businesses alike have embraced wireless communication. This widespread acceptance is due to the fact that wireless technologies expand our freedom to communicate and exchange data, thus improving productivity and convenience to our business and personal lives.

Driven by the lower cost of wireless components, the health care sector is following a similar trend as the growth of wireless networking in hospitals is skyrocketing (see Table). According to the market research firm Gartner Dataquest, “the health care provider market will witness a fundamental transformation in which wireless LANs will become an integral part of hospital networks, and mobile and wireless devices will become prevalent in the clinical setting.”

Gartner predicts that “by 2007, wireless networks will be an integral part of more than 65% of all health care provider network infrastructures.” As hospitals deploy mobile applications to improve operational efficiency, wireless networks will be installed initially for high patient throughput areas, including emergency rooms, critical care wards, and nursing care floors.

Many compare the market acceptance of wireless local area networks (LANs) to the early days of the Ethernet. When Ethernet was adopted as a standard, it

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was adopted as a way to network personal computers. Today, the adoption of wireless standards such as IEEE 802.11b/g (also known as Wireless Fidelity or “Wi-Fi”) and the use of mobile computing platforms form the basis of this wireless revolution. At the same time, clinical caregivers want to do more on a mobile basis and have grown accustomed to receiving information on the fly. These factors have converged and are providing the impetus for increasing acceptance of wireless technologies within the health care industry.

U.S. Healthcare Provider Market, Wireless LAN Spending (Millions of Dollars)							
	2002	2003	2004	2005	2006	2007	CAGR (%) 2002-2007
Healthcare Providers	47.8	61.1	66.7	71.4	74.4	75.8	9.7

Source: Gartner Dataquest (May 2004)

According to published Gartner Dataquest research, properly implemented wireless patient monitoring can help hospitals increase clinician productivity, improve patient outcomes, and lower operational costs.

Why Hospitals are Adopting Wireless Solutions

Health care is an ideal environment for the use of wireless and mobile computing technologies. From a process perspective, the hospital of today can be compared to a logistical or supply chain operation. There are multiple departments through which the patient moves; while at the same time, clinicians need information for real-time decision support. Clinicians must have access to the critical patient information at all times—wherever they are—without increasing their workload.

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Exactly what do health care providers hope to achieve by implementing a wireless solution? The goals include risk reduction when monitoring patients, better patient outcomes, increased staff efficiency and continuity of care (i.e. improved workflow), improved response time, decreased costs in the care process, and compliance with the Health Insurance Portability and Accountability Act (HIPAA) requirements. Here's how wireless technology can answer each of these desired goals.

"To reduce risk, a hospital must automate repetitive tasks to eliminate human error..."

Risk reduction when monitoring patients. Patient safety is always a top priority. To reduce risk, a hospital must automate repetitive tasks to eliminate human error, while allowing technology to work in the background to validate the outcome. Also, patient vital signs data should flow continuously to the clinical information system, whether the patient is on a wired or wireless network.

The ability to monitor patients anywhere within a monitoring unit—in the patient room, in the hallway, even in the elevator—ensures complete and continuous observation. With wireless technologies, patient monitoring is not restricted to the traditional model whereby patient monitors are assigned to each room or bed. Rather, virtually every bed in the hospital can become a monitored bed. Real-time information is available wherever it is needed in the care process.

Improved patient outcomes. When the hospital automates the process of collecting vital signs data and provides easy access to this information on a mobile basis, caregivers can make better decisions.

Clinicians do not necessarily need more information. Rather, they need timely access to information so they can make evidence-based decisions on the spot, without having to search for information. Distributing clinical information—whether it is in the form of clinical alerts or the access of patient information on mobile devices in the wireless world—allows this to happen.

Increased staff efficiency and continuity of care. Today's patient care environment has become information intensive. Multiple disparate devices collect infor-

mation in real-time. However, patient care is foremost, and this often displaces the clinician's ability to keep patient information current in all places.

Many times this information is kept up in a retrospective fashion. Wireless technologies allow the continuous gathering of physiological information wherever the patient is in the care process, which allows caregivers to focus more on the care of the patient, rather than on the equipment.

Improved response time. The response time to clinical events can be improved considerably when the appropriate wireless infrastructure is in place throughout each departmental area.

In the case of an event, it would be ideal if information from a patient monitoring system and/or ventilator were distributed via wireless to the mobile caregiver. This would allow the clinician who may not be in front of a central station to be notified—regardless of location—and enable the appropriate response.

Decreased costs in the care process. An automated flow of information into a clinical information system from real-time physiological and ventilation systems will alleviate the workload and costs associated with the charting of those parameters.

Hospitals can improve the process and responsiveness to alarms when they automate and bring together the real-time information at the point of care, then distributing the relevant information to the mobile worker. This will allow clinicians to make better informed decisions, potentially speeding the patient through the delivery care process.

Compliance with HIPAA requirements. In the wireless world, it is important that proper security measures are in place. Hospitals can ensure HIPAA compliance when they use standards-based wireless technologies, combined with the proper security and network monitoring strategies.

Potential Advantages for the Hospital

Wireless capability turns any hospital bed into a monitored bed. Wireless patient monitoring alleviates the difficulties and expenses posed by hard-wired monitors in some clinical environments.

For example, wireless monitoring is ideal for neonatal intensive care units and operating/recovery rooms where hard wiring can be impractical. It is also a solution for the emergency department, where there can be

an overflow of patients. With wireless systems, beds in the hospital can be a monitored bed.

Standards-based architecture provides investment protection. Because Wi-Fi is the industry standard wireless platform, WiFi-based wireless monitoring is designed to meet the hospital's changing information requirements and protect against obsolescence and the retraining of caregivers to use new products.

Unlike a proprietary wireless solution, a standards-based, open architecture guarantees an upgrade path with the hospital's existing medical devices.

Uninterrupted monitoring ensures continuous surveillance. Wireless patient monitors enable the monitor to travel with the patient as he or she moves throughout the hospital—without losing any data as the patient moves. As a result of the continuous wireless connection, clinicians in other care areas have remote access to vital patient data.

This access can be from the in-house clinical information system or even back out through the wireless network. Clinical information can be readily available and accessed through standard personal digital assistants (PDAs) enabled with wireless accessory cards. Available data can include individual patient vital signs, status information, patient trends, and waveform information.

In essence, information from stationary or telemetry patients can be automatically integrated with the wired clinical or hospital information systems, and later distributed wirelessly throughout the enterprise. The result is uninterrupted patient monitoring, which enables continuous surveillance and enhances care. As a result, there are fewer information gaps to leave doctors and nurses uninformed and hinder lifesaving judgments.

Overview of Correct Implementation of Wireless Technologies

Early stage wireless adoption has been very rapid, and as technologies mature this has created somewhat of a plug-and-play approach to implementation. Information Systems (IS) and network design teams have varied in their “wireless” competency, and some have viewed this as an extension of their wired network.

It is important for the hospital to have a strategic radio frequency implementation plan that includes not only current solutions, but future mobile computing devices as well. As a part of this plan, the first step would be to conduct a complete spectrum analysis of all frequencies occurring throughout the facilities.

Once a complete spectrum analysis is done, it is recommended to properly conduct a wireless site survey. This is not simply a “walk through” with a laptop, but an enterprise approach. There are many tool sets available to import computer aided design drawings and/or blueprints as a first step to a professional design. These tools allow for the actual design and implementation of each access point and allow the hospital's IT team to carefully look at channel management and dBm power levels.

This planning is critical for matching the correct type and gain of the specific antenna as well as for the proper placement of access points. Attention should be given to aesthetics and the overall network design to each intermediate distribution frame and main distribution frame. This assumes that the installation is for indoor coverage only on the unlicensed bands. A whole other situation plays out for outdoor point-to-point/multipoint, licensed, and unlicensed installations.

Additional Resources

Spectrum Analyzers

Many spectrum analyzers are available on the market, but some of the most common for Wi-Fi implementations include:

- www.rohde-schwarz.com
- www.anritsu.co.jp/E/Products/Appli/Wlan/

Popular Tools

Some of the best and most popular tools available to import CAD drawings and/or blueprints include:

- www.airmagnet.com/products/surveyor.htm
- www.ekahau.com/products/survey/
- www.wirelessvalley.com/Products/LANPlanner/LANPlannerSuite.asp

Potential Concerns and Issues

Regarding potential concerns and issues to address when implementing wireless technology in the hospital, several good sources from Cisco Systems go into great depth on this subject, including:

- www.cisco.com/en/US/products/hw/wireless/ps430/products_white_paper09186a0080088791.shtml
- www.cisco.com/en/US/products/hw/wireless/ps430/products_white_paper09186a008011a606.shtml

Potential Concerns and Issues to Address

Just as when planning for medical telemetry systems and the proper design of the antenna system, the same goes for WLANs. In the past, many WLAN access points were deployed without a master plan. Thus as new mobile and voice over IP (VoIP) devices were added to the network, wireless networks suffered from latency issues or poor coverage. Even though wireless networks may have worked for stationary wireless laptops, when a lot of mobile or VoIP devices are added, a new site survey and planning effort is required. That is why it is important to take advantage of either the professional software planning tool sets, or have a certified wireless engineering team partner with the hospital in this regard.

Finally, to ensure that security is protected, the hospital needs to put a plan into place to “protect the air.” It is recommended that intrusion detection system tools be evaluated to add to the complete 24/7/365 protection of the airwaves. For more information, see <http://www.airdefense.net/>

Summary

A standards-based wireless patient monitoring technol-

ogy can lead to significant improvements in productivity and workflow, provide the potential for reduced errors, and decrease the costs of patient care. A proper-

"...properly implemented wireless patient monitoring can help hospitals increase clinician productivity..."

— Gartner Dataquest

ly implemented wireless patient monitoring system can provide caregivers with increased access to vital patient information at all times. This will help health care institutions build a real-time care process, provide a continuous patient record across the continuum of care, and improve outcomes by creating an environment where clinicians can make evidence-based decisions. ■

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Wireless in Action at the University Hospital of Heidelberg

The University Hospital of Heidelberg is ranked number 10 among the top 50 teaching hospitals in the world, and is the only German hospital on that worldwide list. To maintain its prestigious ranking, the institution is committed to staying on the leading edge of innovation. In 2004, Heidelberg opened a new three-story, 280-bed medical center focused on internal medicine with intensive care units and IMC units for cardiology and gastroenterology among others. All beds are monitored, even in non-acute wards, with either stationary or mobile monitoring.

The challenge:

Create a wireless patient monitoring system for the whole hospital; run patient monitoring on the existing hospital network infrastructure.

The solution:

Install a patient monitoring system and implement a virtual local area network-based shared infrastructure that allows wired and wireless monitoring to run on the existing hospital network.

The results:

- Standardization—Contains costs and saves training time by allowing the hospital to use one kind of monitor for every department and patient acuity level.
- Wireless mobility—Enables patients to move around freely within specified coverage areas of the hospital, which positively affects the therapy and recovery of patients.
- Shared infrastructure—Allows the hospital to run wireless and wired patient monitoring on the existing hospital network.