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Managing Security Access

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Wireless technology offers a viable opportunity to make ICUs more mobile and introduces new possibilities for enhanced ICU management and medical care.

Introduction

The intensive care unit (ICU) relies on a variety of bedside devices to deliver care to critically ill patients. These devices include physiological monitors, ventilators, infusion pumps and bedside computer terminals, among others. Each device offers a critical medical service to the patient or reports the patient's condition to the medical staff. Traditionally, these devices are attached to the patient, the bedside head walls and to the hospital networks through a maze of wires and cables, which provide medical service to the patient and electricity and/or data network connectivity to the device. As a result, contemporary ICUs are often choked with cables and wires, limiting the mobility of the patient and the bedside devices attached to them, and the nursing and physician staffs who must navigate the jungle of wires to provide care. Wireless technology offers a viable solution to these problems and opens opportunities for enhanced medical care and device and personnel mobility.

Increased Mobility and Other Advantages

Introducing wireless connectivity into the ICU offers many advantages. First and foremost, wireless technology allows the ICU to eliminate the tangle of wires at each bedside. This allows the medical staff to relocate devices and even the patients as needed. It also creates a tidier, safer ICU room. Because wireless technology offers new opportunities for mobility, a wireless ICU can better manage its space and equipment, optimizing the number of patients served and the number of medical services available to patients throughout the ICU.

Wireless technology may also be used to integrate, through a consolidated wireless network, a variety of bedside devices, which, in a traditional ICU, are typically not networked together. This enhances the ICU's ability to collect, manage and analyze data from bedside devices, which in turn enables ICU managers to easily make decisions based on comprehensive medical data from their own ICU. Specifically, this data could help managers tailor ICU policies and procedures to local caseload and patient flow, further facilitating the operations in their particular ICU.

Placing data from multiple bedside devices onto one, integrated network also enables the ICU to efficiently and effectively communicate its comprehensive patient data to other areas of the hospital. ICU doctors and nursing staff may also take advantage of the networked data to access information about patient status remotely from home or from a nursing station, thus allowing them to respond more quickly to changes in a patient's condition, even when they are not immediately available at a patient's bedside.

Installing a Wireless ICU Network

Converting to a wireless ICU clearly offers medical mobility and management advantages, but the thought of modifying or doing away with traditional, hard-wired devices may seem futuristic and daunting to many ICU managers. Creating a wireless ICU requires physical modifications to the existing, traditional ICU. The key to wireless networking is the installation of access points; these units are bi-directional "Wi-Fi" (802.11) transmitters that provide zones of wireless coverage. The access points link the medical devices wirelessly to the hospital to be accessible beyond the bedside.

Because an ICU usually occupies a substantial amount of space, it may be necessary to install multiple access points, each providing wireless coverage for the devices in their zone (e.g., one ICU room). Thus, although the wireless ICU looks significantly less "busy" than a traditional ICU,

it must be “wired for wireless” through the installation of the access points.

Wireless networking poses its own unique set of challenges. Physical changes in the area of wireless coverage may cause coverage limitations. Wireless zones may become overloaded with transmissions, thus slowing down data throughput. Access points themselves may fail. Security may become problematic as “hackers” attempt to engage the wireless network without proper rights. Thus for wireless to function properly, a 24/7 monitoring system must be developed.

Moving to Wireless

Once the ICU has installed a wireless coverage sufficient to meet its needs, it can begin the transition to wireless operations. All typical ICU devices are now available in wireless formats. The wired and wireless systems can co-exist, as well. The following are a few examples of common bedside devices available in wireless format:

• Monitors

Physiological monitors are among the most common ICU devices and are typically networked together through wired connectivity. Monitoring companies also support wireless integration and many of their devices already in the marketplace contain wireless technology installed directly within the monitor. Thus peripheral or external wireless transceivers are not required to link the monitor to the ICU’s wireless data network. Electrocardiogram (EKG) leads and pulseoximetry devices are also available in wireless format. Invasive blood pressure monitoring is one of the few monitoring capabilities that has lagged behind and remains wirelessincompatible; however, research into adding this capability to invasive monitoring is currently underway.

• Ventilators

Ventilators are typically stand-alone devices and are not networked with a data management system. However, since it is nonetheless important to track the status of ventilated patients and to receive remote alarms when significant changes occur, wireless ventilator management systems that can transmit data on a wireless ventilator network are now available. A wireless transmitter however, must be externally attached to the ventilator. Using this technology, ICU doctors can review patient and ventilator data within their facility via any computer or handheld device with access to the wireless network. The ventilators in turn, can transmit alarm notifications of changes in a patient’s condition to remote paging devices.

• Infusion Pumps

Intravenous infusion pumps, like mechanical ventilators, have largely been used and viewed as stand-alone devices. To date, the pumps have had minimal programming capabilities; today, however, the newer generation of infusion pumps, referred to as “smart pumps” incorporate multiple comprehensive drug libraries and infusion error reduction systems. Wireless connectivity, however, is recommended to optimally use, maintain, and update the pumps and their software.

Wireless also permits the infusion pumps to continuously link to the patient, pharmacy and information management systems. Thus smart infusion pumps are available with integrated wireless connectivity to enable them to function under a care model that enhances patient safety.

• Bedside Terminals

Traditionally, each ICU bedside has a computer terminal, which is standalone, immobile and difficult to see. To be efficient, an ICU needs computers that are both mobile and visible. A decade ago, mobile terminals were rare and expensive. Today, vendors offer wireless carts that provide mobility and connectivity throughout the wireless ICU. In our ICU, we have even introduced telephonic capabilities through the wireless computer carts.

Two conceptual wireless ICU constructs thus emerge. First, the wireless medical devices at the bedside can be grouped with the patient and caregivers to form a cohesive “bedside” patient-device-provider network that is linked to the hospital-wide information system. Second, each group of wireless devices (monitors, ventilators, infusion pumps, etc.), while scattered throughout the ICU, can be viewed remotely as their own virtual device communities.

New Technologies, New Possibilities

In addition to the traditional bedside devices mentioned above, hospitals are introducing non-traditional applications for wireless connectivity into their ICU environments. For example, some hospitals have introduced remote-presence robots, which enable ICU doctors to complete patient rounds remotely. Live images of the patient and bedside devices are transmitted via the wireless network to the doctor’s computer. A live feed of the doctor, in turn, is transmitted through the network to the robot’s screen, adding a personal touch to a remote visit. Other hospitals have used their wireless network to support patient bar-coding initiatives. Through bar coding, the medical staff can identify the patient, link the patient to the medical or nursing caregivers and to the bedside devices and transmit patient- specific medication orders to the infusion pumps throughout the wireless coverage area.

Conclusion

In conclusion, wireless technology has unique applications in the ICU. Wireless networking applies to the patient, the ICU itself, and the entire hospital. It allows for centralization of devices that previously lacked interoperability, creating better data and device management possibilities, and enhanced mobility throughout the ICU. However, wireless networks require access point installation, introduction of wireless connectivity to medical devices and plans to overcome security and maintenance challenges that are different from those encountered in a traditional, wired ICU. Nevertheless, the benefits of a wireless ICU demand that we consider moving towards wireless technology in the near future.

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