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The Wireless Impact

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In the future, most information management will be handheld, allowing clinicians to access patient information wherever they are.

With the promise of benefits, such as improved productivity, better patient outcomes, and decreased cost of care, wireless technology is rapidly transforming the face of health care. It is not unusual to see today's clinicians accessing electronic medical records through any phone in the hospital, or using handheld personal digital assistants to enter and receive data at a patient's bedside.

Manufacturers likewise are working as quickly as possible to make their devices comply with the Institute of Electrical and Electronics Engineers Inc's wireless standards, and information technology (IT) companies are fine-tuning methods of creating ubiquitous coverage, despite the inherent obstacles in hospital design.

"Health care facilities in general are very radio frequency (RF) unfriendly due to the variety of construction materials, shielding for radiology, and structures like elevators and stairwells," says Al Mockaitis, director of sales for InnerWireless in Richardson, Tex, which provides solutions for managing the wireless environment in hospitals.

"The biggest problem that most hospitals face today is that there are areas with no coverage throughout the structure," he continues. "InnerWireless is working around that issue by specifically designing an antenna system within the building. That infrastructure is managed within a certain frequency so that everything is at a predetermined power level and there are no overpowering signals in the hospital."

Biomedical technicians likewise are moving into a new realm where their skill set must include knowledge about topics like RF interference and wireless infrastructures.

“Traditionally, biomedics learn how to service equipment but not how RF works, and with many systems moving up into the higher frequency range, most people don’t understand that,” says Dara McLain, EMC engineer and program manager for interference investigations for Philips Medical Systems, Bothell, Wash.

Since biomedics do need to understand that a higher frequency operates differently, and that means that different things are affected than in a lower frequency, McLain highly recommends some continued education efforts.

“I don’t think that today’s biomedics must run out and get an electronics degree, but they can certainly expand their electronics knowledge through online classes, 2-year programs at community colleges, or seminars,” she says.

They can also expand their knowledge by working more closely with their IT department. “Traditionally, the biomed department and the IT department don’t work together, but the line between these departments is becoming blurred,” says Eric Sluder, director of Enterprise Telecommunications for Alverno Information Services, a wholly owned division of the Sisters of St Francis Health Services Inc, headquartered in Mishawaka, Ind.

“Biomedics should welcome IT into their area of responsibility and show them the medical devices they are thinking about including on a new wireless network,” Sluder says. “Biomedics think beyond the typical IT realm, and they know that continued wireless coverage is vital when a nurse wheels a patient into an elevator. So being involved up front avoids problems down the line, and it helps build a relationship for usage down the line, too.”

Frequency Management

From the moment health care facilities began using medical telemetry applications, the telemetry applications have experienced interference from other devices operating in the same spectrum. To counteract such problems, the Federal Communications Commission designated frequency bands for primary or coprimary use by eligible wireless medical telemetry users to provide RF interference protection. A number of interference problems have been eliminated due to these designations, but not all of the problems.

Medical manufacturers also are required to provide information about electromagnetic compatibility (EMC) issues for their equipment in order to receive US

Food and Drug Administration (FDA) approval for a device that transmits or receives RF.

“When we test a new device for resale in our lab, it meets or exceeds medical EMC test standards,” McLain says. “However, any EMC issues with the device are disclosed in accompanying documentation, as defined by the standard.”

While medical device manufacturers try to develop equipment that is not in the same frequency band, sometimes health care facilities implement equipment from different manufacturers.

“Telemetry frequency bands are protected, but that’s a loose term because other things can occur that aren’t intentional,” McLain says. “For instance, sometimes hospitals will buy two different telemetry systems and try to operate them in the same frequency band. However, two signals cannot occupy the same frequency at the same time. The physics of that are indisputable.

“So if there is telemetry operating on the third floor, and a department in the basement installs a different telemetry system, you may experience interference that will cause one or both systems to work intermittently. We have to be sure those devices are not on the same frequency, and that’s where a frequency manager comes in handy.”

While a frequency manager does not necessarily need to know what all the different frequencies do, they do need to keep track of all devices in use in the hospital and keep a central database that contains all the information, such as user manuals and technical data sheets, about the equipment that uses each frequency. Keeping track of such data also prevents the problem of running out of bandwidth as more biomedical devices and computers are added to any network.

“There is a lot of research being done about having greater bandwidth for wireless, but we don’t have that option yet, so we have to manage what is on the network,” Sluder says. “The worst case scenario is that we have to shut down the system or the device, and that’s why we want to take a proactive approach or it could be a costly mistake.”

A frequency manager also ensures proper management of the EMC environment through such avenues as periodic RF surveys to maintain an accurate picture of what is in the environment, and preventive maintenance (PM) of hospitalwide systems, such as heating, ventilation, and air conditioning (HVAC); and lighting.

“At this point, most hospitals prefer to hire out to have RF surveys done so they know that they are getting trained professionals,” McLain says. “But there’s no reason that

biomedics can't do those surveys if they understand what's needed and the equipment used."

How often RF surveys need to be done depends on the hospital. If the facility is small and it can operate for 5 years without installing something new, then a survey once per year to make sure there's no new interference from inside or outside the building is sufficient, according to McLain.

"If a facility decides they want to install something critical to patient care, like a wireless ventilator or infusion pump, then an environmental survey should be done to make sure there is no interference before installation," she adds.

When there is interference, McLain says she would like to see hospitals be less fearful of the FDA and report the problem.

"The FDA can really help them, but I think facilities are leery about filing issues about interference that they've had," she says. "It would be helpful for them in the long run if more hospitals sent information about interference issues that could be included in databases. The more information we have, the better we can change standards and force manufacturers to control the kinds of issues that lead to problems."

Incidental Radiators

Some of the most common interference problems that McLain has witnessed are due to the use of high-powered walkie-talkies. These devices transmit at a very high power that creates amplifier saturation and often causes problems with wireless networks.

"When those radios are used near access points or antennas, they run the risk of causing interference with the system," McLain says. "If they have a strong enough signal, such devices don't even have to be in the same band to create interference. We can't have signals to critical care patients being interrupted, so this needs to be monitored or prevented by using a paging system or a walkie-talkie phone system that is low power and operates out of band."

Incidental radiators, such as high-powered walkie-talkies, also may interfere with medical devices, which is where PM of nonmedical equipment becomes important.

"The facilities department often manages in-house systems like HVAC or fire alarms, and they also need to confer with the frequency manager because much of the equipment they buy can be incidental radiators," McLain says.

One hospital she worked in had a programmable fire alarm system on the top floor,

directly above the intensive care unit. The manufacturer of the fire alarm knew about the potential for interference, so there was a minor adjustment option available to obviate the possible interference.

“A frequency manager could see that in the data they collect about every device in the hospital,” McLain says. “It’s all about keeping in touch.”

McLain also points out that some hospitals do not pay attention to recommended replacement cycles because they want to save money.

“It’s prudent to implement PM especially in critical care areas of the facility,” McLain says. “I have visited facilities where they have had interference on and off over a period of several months, and the culprit is a defective lighting ballast. If a facility traditionally does not replace that ballast until the light goes out, then it can cause interference long before that point.”

The same thing goes for any machine that has a motor, like a floor buffer. Often the motor brushes in a buffer are not replaced until they no longer work, but McLain again stresses that they should be replaced once they emit noise because that also can cause interference.

“Particularly with an item like a floor buffer that moves around, it can be hard to track down the source of interference,” she says. “Preventive maintenance avoids such problems.”

With the portability of medical devices comes another challenge to biomed: keeping track of equipment spread around the hospital.

“If they can’t find it, they can’t do regular maintenance,” Mockaitis says. “The RFID [radio frequency identification] system allows anyone to find any piece of equipment anywhere in the hospital, down to room-level accuracy.”

Preparing for the Future of Wireless

For now, McLain says it is still pretty unusual to have a frequency manager or even a staff that is familiar with the frequencies in use. That will have to change if biomed wants to keep pace with the technology.

“Hospitals have only begun scratching the surface of these handheld devices,” Mockaitis says. “Most information management in the future will be handheld. More clinicians will be able to access patient records, and someday they will be able to walk around the whole city and get information wherever they are located.”

“There is a whole new thought process about wireless technology today,” Sluder says. “Today there are more expectations about the dependability of wireless networks. A wireless infrastructure needs to be as reliable as any other utility we depend on today. The technology has never been in that limelight before.”

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