AAMI Members Weigh In
Survey Sheds Light on Use of Wireless Technology

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Since the first wireless patient telemetry systems were introduced in the 1970s, the technology used to transmit real-time patient information over the airwaves has gone through a number of generations. Initially, the radio frequency (RF) technology was purely analog, typically using frequency modulation. The electrocardiogram (ECG) waveform would get “noisier” as the patient moved out of range, but nurses became quite adept at making out the ECG even in the midst of considerable noise.

In the 1990s there was a transition to digital signal transmission. This approach had the advantage of allowing user channel programming (previously they had to be set up at the factory), the possibility of using diversity to improve reception, and very clean signals when the patient was in range—but no signal when the patient was out of range. This took some getting used to and much more attention was required for antenna placement.

These systems operated mostly in the very high frequency (VHF)/ultra high frequency (UHF) TV bands, making use of unused channels in a given locale. Sometimes, a new TV station would come online, creating an issue for a hospital that had telemetry systems using that channel and necessitating that the devices be reprogrammed. In the late 90s, the testing of the new digital television technology in the Dallas area interfered with the telemetry systems at Baylor Health Care. This incident was the impetus behind the Federal Communications Commission (FCC) creating the wireless medical telemetry system (WMTS) bands, currently used by many patient telemetry systems in the United States. The UHF/VHF bands are still used in the rest of the world.

Currently, we are seeing a wide expansion in the number of technologies that can be and are used for patient ambulatory telemetry and medical device instrument wireless. Vendors have released systems that operate in the WMTS bands (typically using proprietary technology), the industrial, scientific, and medical (ISM) bands using 802.11a/b/g, Zigbee, Bluetooth technology, and there are even potential uses of cellular technology. Given all the possibilities, we thought it would be interesting to see what members of the AAMI community had installed and how they thought things might change. To that end, we created a survey that was distributed to AAMI members.

The survey was sent out in May 2011 to approximately 4,000 AAMI members, and we received a total of 124 responses (a 3.1% response rate), primarily from biomedical equipment technicians (BMETs) and clinical engineers (Figure 1). Hospital types (Figure 2) were equally represented among community, general and teaching/university facilities, along with some specialty and other types. We also had a relatively...
even distribution of respondents in terms of hospital size by bed count (Figure 3).

To get an idea of the type of wireless medical devices hospitals currently use or plan to purchase in the future, we can see from Figure 4 that respondents reported that ambulatory telemetry systems are currently the dominant wireless devices, followed by multiparameter instrument telemetry (wireless bedside monitors), and infusion devices. Respondents believe that proportionally more spot check monitors, infusion devices, SpO2 monitors, and glucose monitors will be purchased in the future. The expected future usage of wireless bedsides is almost double the growth rate than that of ambulatory telemetry, probably due to the current market saturation of ambulatory telemetry devices, and the convenience of portable multiparameter bedside monitors.

In terms of nonmedical wireless devices used in a hospital (Figure 5), phone, such as voice over Internet protocol (VoIP)/cellular/smartphones, computers on wheels (COWs), pagers, and bar code scanners are the most popular. Looking ahead, radio frequency identification/real time location services (RFID/RTLS) appears poised to be the largest growth area for other wireless devices, and phone usage shows continued strong growth for all combined categories.

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As mentioned, we were particularly interested in the preference of radio bands and technology for ambulatory telemetry systems. For installed systems (Figure 6), almost 70% of ambulatory systems and 52% of instrument wireless systems operate in the WMTS bands, with most of the remaining 17% of ambulatory and 35% of instrument wireless using 802.11a/b/g in either the 2.4 GHz or 5 GHz bands.

When asked about their preferred ambulatory frequency band (Figure 7), the WMTS bands, especially the 1.4 GHz band, were viewed as most favorable, potentially indicating a greater comfort with an established medical band despite some of its known limitations and
challenges. There appears to be a strong preference for 1.4 GHz WMTS over 608 MHz, potentially due to less crowding and less interference sources in the 1.4 GHz band. Only a very small percentage (6%) found the WMTS 1.4 GHz band unacceptable.

With respect to the much promoted Wi-Fi bands, there was far less clear preference, and much greater uncertainty, for using any one of the 802.11a, 802.11b/g or 802.11n standards over WMTS. There was also a consistent average of approximately 18% of respondents viewing each Wi-Fi band as unacceptable, potentially indicating these bands have yet to prove that they are viable for ambulatory telemetry. Instrument wireless, on the other hand, was twice as likely as ambulatory telemetry to utilize Wi-Fi bands (Figure 6).

When looking at preferred frequency bands from a different angle, specifically the perceived risk to patient safety when operating in a particular band (Figure 8), it became clear that the Wi-Fi bands carried a much higher perceived risk and uncertainty than did either of the WMTS bands, further supporting some of our earlier speculation. Once again, WMTS 1.4 GHz was viewed most favorably (no or low perceived risk), followed by WMTS 608 MHz. This was true of both ambulatory telemetry and instrument wireless.

One of the options for devices that use 802.11a/b/g/n technology is to install those systems on the hospital’s existing wireless 802.11 infrastructure, thereby sharing that infrastructure and potentially saving considerable installation and maintenance costs. When we asked about preferences for each wireless technology (Figure 9), respondents indicated a preference for a proprietary WMTS infrastructure well above any 802.11 infrastructure—either dedicated or shared. There was also no clear preference for 802.11 vendor installed closed/dedicated networks versus hospital shared network infrastructures.

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network infrastructures as a result. Another 19.2% favored shared 802.11 networks primarily for the infrastructure cost savings that they expected to be realized by not installing and maintaining multiple or proprietary networks. (The authors wonder whether 802.11 would be perceived more favorably if we had more information technology (IT) respondents participate in the survey.)

Finally, we asked the community about IEC 80001, the international standard on risk management for networks incorporating medical devices, and the recent medical device data system (MDDS) ruling from the U.S. Food and Drug Administration (FDA), and whether they might impact the type of networks that will be deployed. About 50% of the respondents felt that both encourage dedicated (closed/proprietary) networks, with about 25% indicating they needed further education on IEC 80001 (Figure 10) and MDDS (Figure 11).

In summary, our impressions of the results of this survey are that, not surprisingly, biomedical equipment technicians and clinical engineers are a relatively conservative group. While it appears that, overall, the use of wireless medical devices as well as nonmedical devices is a large and important part of a hospital’s standard of care and will continue to grow, the use of the relatively new 802.11a/b/g/n technology for critical applications, such as ambulatory telemetry or even instrument wireless, may need more time to garner widespread support and implementation.

Patient-monitoring vendors are prepared either way; many already offer wireless options in either the WMTS bands or the WiFi 802.11 bands for ambulatory telemetry, wireless
bedsides, or both. In the end, the market direction will be determined in part by the hospitals' adoption of these technologies, and the industry's ability to deliver robust, reliable, and secure wireless networks in these bands.

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For More Information
To learn about the FDA's MDDS rule, go to:
www.fda.gov/medicaldevices/productsandmedicalprocedures/GeneralHospitalDevicesandSupplies/MedicalDeviceDataSystems/default.htm
To learn more about IEC 80001, go to:
www.aami.org/hottopics/80001/index.html

Figure 10. Impact of IEC 80001 on Network Installation Strategy

Figure 11. Impact of MDDS on Network Installation Strategy

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