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Wireless medical devices advance, weather balloons aside

Until a few years ago, being fitted with an implantable pacemaker or defibrillator meant regular trips to the hospital to check the device and review its activity. But the latest generation of these devices, which send electrical signals to the heart to stop it from beating erratically, can update clinicians without patients leaving the house—or even waking up.

According to researchers at the recent Bionic Health meeting in London last month, people may soon see themselves kitted out with a whole network of such devices, both on and in the body. They envision these devices working together to monitor our vital functions and to communicate this data wirelessly with each other and the outside world via radio waves. Ultimately, say scientists and industry developers, the wireless devices could trigger an automatic treatment, which could range from electrical stimulation to the release of drugs.

In addition to benefiting patients, such networks of wirelessly communicating implants may also prove to be an enormous boon to medical researchers by generating reams of detailed medical data.

As far back as seven years ago, the medical device giant Medtronic introduced pacemakers and defibrillators that communicate wirelessly via its CareLink system. According to the company, this system has been introduced in 30 countries and is used by over 360,000 patients.

With CareLink, the implanted pacemaker or defibrillator regularly communicates with a nearby monitoring station, providing information on how both it and the heart are functioning. The monitoring station is hooked up to a regular phone line, allowing it to send all of this information directly to the appropriate clinician.

Getting to this point required solving a number of challenges. This included finding a radio frequency that could both travel unhindered through the human body and communicate data efficiently. You also don't want any interference from other forms of wireless communications, such as mobile phones.

"We needed a frequency that's a bit of a sweet spot," Henry Higgins said at the recent London conference. Higgins works as a design engineer at Zarlink Semiconductor, a Canadian company that develops wireless communicators for implant manufacturers. This sweet spot turned out to be at 403 megahertz, known as the MICS band, which now has worldwide approval for use solely by medical devices and (rather bizarrely) weather balloons.

Charged up

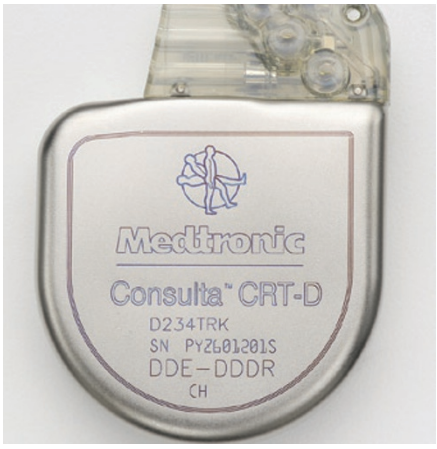
Small, implantable devices can only use tiny batteries. This generally presents a challenge, as miniature batteries produce a limited amount of power. To help get around this problem, developers create devices that only have to transmit information over a short distance—around three meters. This is why, for example, Medtronic's implantable devices communicate with a nearby monitoring station.

Still, challenges remain. "Battery technology is one of the limiting areas that need to be developed," Geoff Morris, Medtronic's regional vice president for the UK and Ireland, said at the London meeting.

By shrinking the devices, researchers are making them easier to power and to implant. For example, Medtronic is now working on tiny wireless heart monitors with a volume of just one cubic centimeter, which can be injected into patients through a catheter to measure their heart beat. According to Morris, such devices should reach the market within around 18 months.

Medtronic has been quick to realize that the large amounts of data generated by these implants could be invaluable for medical research. Already, it collates and analyzes the data generated by its pacemakers and defibrillators via the CareLink system, after removing any link between the data and specific patients. In conjunction with academic researchers from bodies such as Johns Hopkins Hospital and Washington University School of Medicine, Medtronic is now using these data to help answer specific questions about heart disease, such as whether weak hearts cause arrhythmias or vice versa.

According to Medtronic, it is currently the only company able to offer wireless monitoring for all of its heart devices, but other companies are now entering the field. In July 2009, the US medical technology company St. Jude Medical announced that the US Food and Drug Administration had approved its own wireless pacemaker system, which works in a similar way.



Medtronic

Can you hear me now? Devices go wireless

Meanwhile, companies such as GE Healthcare are busy developing the next generation of wireless medical devices. These will monitor a whole range of health parameters, including pulse, blood glucose levels and blood pressure, forming medical body area networks (MBANs). But as these monitoring devices proliferate, the MICS band will no longer be sufficient for transmitting all of the information.

In August, the US Federal Communications Commission (FCC) began accepting comments on proposed rulemaking on whether it should devote a portion of the wireless spectrum for MBANS.

"The FCC proposed rule making is significant because, if enacted, it would set aside some spectrum that would allow us to really innovate in this area," says David Freeman, general manager of parameters for GE Healthcare.

GE Healthcare, with support from Medtronic, petitioned the FCC to allocate a portion of the spectrum for use solely by medical devices. The FCC is now considering this petition, and innovators of wireless devices hope that it will signal its final decision soon.

Jon Evans, Chichester, UK