An apple a day: Technology transforms healthcare

As the global population ages, and chronic diseases continue to rise, wireless technology has a critical role to play in delivering better and more affordable healthcare outcomes

There is a paradox in healthcare, in fact there are several. We are living longer, but getting sicker. We are spending more money than ever on healthcare, yet service levels are declining. Governments want to increase health care affordability, and reduce health care delivery. These seeming contradictions are why alongside food security, climate change, and international financial stability, healthcare was touted as one of the leading global issues at last year's World Economic Forum Annual Meeting, held in Davos-Klosters, Switzerland.

According to the World Health Organization (WHO), in the last 15 years average life expectancy increased by five years, at the same time noncommunicable diseases—diabetes, heart disease, obesity, cancer—all continued to rise at an alarming rate. Together they have fueled a rising demand for healthcare products and services, and that has come at an enormous financial cost. According to market analyst Deloitte, the spend on global healthcare will reach approximately $8.7 trillion by 2020, as both the public and private sector invest heavily in improving healthcare outcomes for a graying and growing world population.

Technology, of course, has a crucial role to play. Not only the CT scanners and MRI machines that require a capital outlay in the tens of millions of dollars, but wireless technology too, that comes with a much more affordable price tag. Wireless technology is already well entrenched in hospitals for things like enterprise-wide tasks—such as analyzing operational data, managing staff workflow, automating environmental monitoring, or tracking medical equipment—and improving the quality of care by monitoring hand hygiene compliance and increasing patient security. The use of wireless technology, both inside and outside hospital walls, is set for a remarkable growth curve, and, once end products have passed strict regulators such as the U.S.-based Food and Drug Administration (FDA), Bluetooth low energy in particular promises much in medical applications.

Bluetooth low energy's interference immunity shields against other RF sources such as electrosurgical devices

The Bluetooth advantage

Bluetooth low energy technology offers a number of advantages in the healthcare sector. For example, the technology's interference immunity allows it to coexist alongside other 2.4-GHz wireless technologies such as Wi-Fi. 128-bit AES encryption keeps sensitive data safe during transmission, while ultra low power consumption extends battery life enhancing convenience. Further, medical staff can get on with their job of patient management, while Bluetooth low energy-enabled devices reduce human error by ensuring patient data is accurately and securely transmitted to a central computer or vital signs monitor.

These devices don't only dumbly transmit data. A Bluetooth low energy-enabled device, for example a blood glucose monitor, could also instruct an IV drip to alter its rate of delivery to suit a patient's insulin levels. By allowing medical devices to make routine determinations medical staff can direct their attention to decision-making that does require specialist human intervention.

The other key factor in the case for Bluetooth low energy extends beyond the hospital walls. Hospital-based health-care is one thing, but health care in all its forms happens far more outside hospitals than in them, away from medical staff, GPs, or trained healthcare professionals. Consumers have already adopted Bluetooth low energy technology into their daily lives, and the popularity of wirelessly connected wearable and non-wearable devices performing health-based functions is booming.

No cost barrier

While developing a smart Bluetooth low energy wireless medical device is not trivial, thanks to today's powerful, highly-integrated Systems-on-Chip (SoCs) and widely-used software and hardware development tools, design has never been easier. For example, Nordic Semiconductor's nRF51822 SoC is a proven and flexible Bluetooth low energy chip (with support for other RF protocols) incorporating a 32-bit ARM Cortex M0 CPU and

generous Flash memory and RAM resources that all make it a good choice for wireless medical applications. Moreover, this performance comes at a sub-$2 price point (for volume purchases) allowing use in low-cost medical devices, including disposable ones. This is a market which is set to boom as evidenced by a recent report from analyst Market Research Future which predict that the market for 'smart' (wireless) asthma inhalers would be worth $1.6 billion by 2022.

One company that sees the opportunity that exists for innovation in wirelessly-connected medical devices aimed specifically at consumers, is Canadian digital health specialist, Aterica Health Inc. Formed in 2012, the company recently released its Veta Smart Case & App, a Bluetooth low energy wirelessly connected carrier for epinephrine auto-injectors, used to administer a dose of adrenaline in the event of anaphylaxis as a result of an allergic reaction.

Veta Smart Case is compatible with EPIPEN auto-injectors and generic to EPIPEN auto-injectors, and employs Nordic's nRF51822 SoC to provide wireless connectivity to Bluetooth 4.0 (and later) smartphones and tablets running the Veta App. In turn, the Veta App notifies the user and their invited support network in the event they become separated from Veta Smart Case, if the auto-injector fails to remain within a temperature range they set, if it is approaching expiry, or if it is removed from the Smart Case.

"Veta Smart Case is a novel product that clearly demonstrates how the application of Bluetooth low energy wireless can make medical conditions easier to manage," says Geir Langeland, Director of Sales & Marketing at Nordic Semiconductor.

Another company providing Bluetooth low energy medical innovation outside of hospitals, but in a professional healthcare environment, is Fort Lauderdale-based CarePredict Inc. The company recently released a wrist-worn device that monitors an individual's activity and behavior patterns, location, as well as providing a touch-button call system for real-time communication with caregivers. With an aging population increasingly requiring formal, facility-based care, the 'Tempo' wearable provides a solution to the problem of improving healthcare service levels while at the same time controlling the cost of doing so.

Tempo combines real-time observations with a machine learning platform to observe changes in seniors' activity

"Technology, of course, has a crucial role to play in healthcare. Not only machines that require a capital outlay in the tens of millions of dollars, but wireless technology that comes with a much more affordable price tag"

Designed for seniors or other users requiring supervised care, Tempo is based on the premise that changes in patterns of daily activities—such as eating, drinking, bathing, walking, and sleeping—are an earlier indicator of upcoming declines in health than physiological measures. The wearable combines continuous, real-time observations with a machine learning platform to observe patterns in daily activities and alert on anomalies, for example if the user is failing to eat or bathe with their usual frequency.

The Veta Smart Case notifies the user if they become separated from their epinephrine auto-injector

"In person, caregivers act as the human observers who are best situated to catch these changes in activity patterns," says Satish Movva, Founder and CEO, CarePredict Inc. "But human observation is unreliable. Hence we came up with a system that can take their place using continuous machine observation to [follow] patterns and alert on anomalies."

Tempo employs a wide range of sensors and proprietary algorithms monitor daily activities. This data is combined with contextual information to replace human observation for most activity and behavior patterns. The data is transferred to communication hubs placed throughout a senior group living facility or care home, using Nordic's 2.4-GHz proprietary wireless connectivity provided by the 3 by 3.2mm wafer-level chip scale package (WL-CSP) variant of Nordic's nRF52832 SoC.

Each hub also employs a Nordic nRF52832 SoC ensuring interoperability and allowing the data to be synced to the closest hub as a user moves throughout a facility. The hubs in turn forward the data to the machine learning back-end via the facility's Wi-Fi network. The machine learning back-end analyzes the data for anomalies and if one is detected, an alert is raised.

Veta Smart Case and Tempo are examples that demonstrate how Bluetooth low energy-enabled devices capable of improving healthcare outcomes now proliferate, and it's a trend that will continue as the cost of the wireless chips continues to fall dramatically, while at the same time offering the capability to perform ever more complex processing tasks. The universality of Bluetooth-enabled smartphones completes the picture. While technology may never replace a doctor's clinical experience or instinct, the traditional healthcare model of complete reliance on the physician is shifting, and technology is increasingly sharing the burden while reducing the costs. ■