

Adhesive-Based Remote Patient Monitoring and The Internet of Things (IoT)

April 2015

One of the early areas of adoption for the internet of things (IoT) has been wearable technology. We often think of technology devices as being directed by our own active queries through search engine interfaces or mobile applications; however, wearable technologies are allowing for an increasing number of solutions that passively collect and communicate data directly from the human body.

McKinsey & Company referenced these trends early on, back in 2010:

[S]ensors and data links offer possibilities for monitoring a patient's behavior and symptoms in real time and at relatively low cost, allowing physicians to better diagnose disease and prescribe tailored treatment regimens. Sensors placed on the patient can now monitor many of these signs remotely and continuously, giving practitioners early warning of conditions that would otherwise lead to unplanned hospitalizations and expensive emergency care. Better management of congestive heart failure alone could reduce hospitalization and treatment costs by a billion dollars annually in the United States.¹

If these solutions promise this level of cost savings in the United States alone, one can imagine just how attractive this kind of medical care solution is across a broader array of healthcare needs, and on a global scale.

We are not just talking about the future at this point. Such devices are now entrenched as viable solutions in the healthcare industry. According to ABI Research Inc, around 80 million wearable sensors will be in use for health-related applications by 2017.² Juniper Research estimates that the wearable technology market overall will grow to \$80 billion by 2020.³

Case Example: Wearable Monitoring Patches

Remote patient monitoring is made possible through the use of various devices, including smartwatches, wristband sensors, smartphone peripherals, and even brain-computer interfaces (BCIs). One category of wearable sensor that shows great promise is continuous wear disposable patches that are often worn for a period of days and then discarded.

Such monitoring patches use "rich sensor technology to enable [transmission of] information wirelessly, and possibly engage in two-way communication for real-time adjustments".⁴ Disposable patches are used to measure vitals such as blood glucose and potassium levels and aim further to measure kidney function and electrolyte balance.

¹ McKinsey Quarterly. *The Internet of Things*. McKinsey & Company. March, 2010. Available at http://www.mckinsey.com/insights/high_tech_telecoms_internet/the_internet_of_things

² Medical Device and Diagnostic Industry Online. *Adhesive-Based Technologies Stick to Home Healthcare*. August 30, 2012. Accessible at <http://www.mddionline.com/article/adhesive-technologies-home-healthcare>

³ Nusca, Andrew. The key to an \$80 billion wearables market? Invisibility. *Fortune*. February 24, 2015. Available at <http://fortune.com/2015/02/24/invisible-wearables-market/>

⁴ Swan, Melanie. *Sensor Mania! The Internet of Things, Wearable Computing, Objective Metrics, and the Quantified Self 2.0*. *Journal of Sensor and Actuator Networks*. November 8, 2012. Available at <http://www.mdpi.com/2224-2708/1/3/217/htm>

Early generation patches were primarily focused on delivery as opposed to data collection and communication. Examples include nicotine patches and birth control patches. But, not only is the communicative nature of newer generation IoT patch technology dramatically different, but so too is the nature of the patches themselves.

Examples include MC10 Inc. (<http://www.mc10inc.com/>), which has developed "stretchable electronic tattoos" that are essentially thin flexible electronic patches, and iRythm (<http://irhythmtech.com/>) has developed the ZIO patch and a host of services surrounding the technology.

A Corollary Technology: Adhesives

There are a number of key challenges that remain in the design of the adhesives themselves in order to enable a host of possible new devices down the road. John Bobo, Scapa Healthcare's associate director, R&D for healthcare, North America explains that "the construction of a suitable adhesive for wearable medical device applications isn't always straightforward. You must make sure that all the components work together, including the skin adhesive, the substrate, and the device-hold adhesive. This means that an adhesive for these applications will have two different types of bondable surfaces."⁵

So, while many opportunities exist and will present themselves for adhesive-based remote patient monitoring, it is important to remember that the further development of the adhesives themselves will play an important role in the process. The nature of the devices dictate the requirements to some extent, but the nature of the surface to which the device is to be bonded also plays an important role. Not to mention, the variations in skin characteristics and body curvature across the population of users constitute an important variable. One company whose purpose it is to meet these goals is Adhesives Research, Inc (<http://www.adhesivesresearch.com/>).

A Closer Look: iRythm's ZIO XT Service for Cardiac Monitoring

Utilizing their proprietary ZIO device, iRythm Inc offers the ZIO XT Service as a long-term, continuous cardiac monitoring option. The company posts a number of peer-review publications on their website in support of their claim that the service produces "a higher diagnostic yield and change[s] patient management - sooner in the diagnostic pathway - compared to traditional approaches".⁶

While this is an advanced example of remote patient monitoring, the patient is still required to return the device to iRythm Clinical Centers via a postage paid mailer after wearing the patch for a period of up to two weeks. Certified Cardiographic Technicians (CCTs) at iRythm analyze the data and provide physicians with a report of their findings.

While other monitoring devices, such as those offered by MC10 Inc, "enable doctors to treat or alert patients remotely, and allow family members to check on each other"⁷, services such as the ZIO XT Service seem to set an early norm for the use of adhesive patches for the monitoring of patients. But, as these technologies and services continue to take hold, it seems increasingly likely that real-time

⁵ Medical Device and Diagnostic Industry Online. *Designing Adhesives for Wearable Applications*. September 10, 2014. Available at <http://www.mddionline.com/article/designing-adhesives-wearable-applications>

⁶ iRythm Website. *Services - ZIO XT Service*. Available at <http://irhythmtech.com/zio-services.php>

⁷ MC10 Website. *Digital Health - Remote Monitoring*. Available at <http://www.mc10inc.com/digital-health/remote-monitoring/>

connected services will take on a greater foothold, beyond trials and into the mainstream of healthcare services. The apparent effectiveness and cost-savings promised would seem to make the greater prevalence of these services just a matter of time.