

# Chapter 66

## Health Wearables Turn to Fashion

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### ABSTRACT

*Microelectronics is shrinking health equipment in size, cost, and operability, thereby moving it from the medical to the consumer market. A typical example is the oximeter. Originally, it was the bulky helper of the anesthetist in the operating theatre, but gradually it has become a routine check for hospital admittance and is rapidly shaped as a simple consumer item, similar to a smart thermometer. The success is inspiring for more. A variety of sensor types are being experimented with to capture the vital data for health in general, and fitness in particular. Accessories are placed in, on, and around the body, and together with the smartphone, they are rapidly becoming part of a “fashion statement.” Some sensors are integrated into a single product; some are wirelessly connected to one or more wearables to provide extensive services.*

### INTRODUCTION

In the early years of manned space exploration, it is observed that astronauts easily lose a sense of time. Consequently they forget to eat in time and are not constantly fit to operate. From the need to monitor the physical condition of astronauts during travel, it became customary to equip their clothing with health sensors (Soller, 2002). One can see this as an early instance of health tele-monitoring.

These measures originate from the customary monitoring of test pilots to find the effect of extreme flight situations on the human body. But in space travel, the monitoring was not just performed during a couple of minutes but routinely for weeks or even months. This has been extended to other situations where a human pilot is confronted with extreme, potentially life-endangering situations, such as car racing. In all such situations, the clothing can be rigged with a wired network of a fixed-design sensory network and connected to a single control room (Jafari, 2006).

With the advance of microelectronics, a potential consumer market is opening. Mobile Health (m-health) is a technical challenge at the crossroads between personal fitness and hospitalization costs. Lack of exercise and/or bad nutrition undermines health and brings diseases such as heart failure and diabetes

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that can be hardly cured once become easily noticeable. Ultimately hospitalization cannot be avoided. Such stays will be regular and lengthy while surgery will be part of the service.

Tele monitoring is currently tested to reduce the length of hospital stays and the number of check-up visits by providing post-surgery health monitoring at home over remote links. On the other hand, a proper life style can delay the advent of diseases or even preclude their coming. The current research interest is to collect data on large groups of people to identify risk groups. Then persons with a high risk can be identified and will receive pre-screening. Consequently, organizing special heart failure and diabetes clinics reduce hospital costs.

People do fitness in order to stay in shape. Usually it requires a regular doctor visit to ensure that the training does not damage the person's health. Self-quantification allows the person to play doctor himself, making the health check available constantly. There are little more health-related products in the common house than the thermometer, scales, cough drops and the medicine cabinet. Tele-monitoring requires additional 2,500 Euro worth of equipment to be installed in the house of the patient. This price tag cannot be tolerated for the average household, but the insurance may pick up the tab for the approved patient. Usually health-monitoring equipment is found in clinics and fitness clubs, where many people can take advantage. The modern equivalent is the 'kiosk': a dedicated booth in public places in and outside hospitals that can be visited at will and provides equipment in a direct link to the hospital infrastructure.

M-health is the next step to bring affordable healthcare in the home, and to any place where a person goes. It can be attached as simple gadgets or be integrated as plaster, garment or ornament. But it will only be more than a consumer gadget, when it (a) gets medical quality information and (b) communicates that information to the medical world, if desired and necessary. Further into the future, but not that far away, is the caring home, where healthy dwellers are measured to ensure that any health-endangering conditions can be detected and brought to the attention of a physician in time. According to the World Health Organization (WHO) such precautions can reduce the amount of visits to the hospital by 90% (WHO, 2011)!

In the following, the history of wearable devices is outlined, coming from m-health to e-fashion. Then the state-of-the-art of oximetry technology is discussed, leading to an overview of trends in consumer health technology, leading to conclusions on their role in personal life-style improvement.

## **BACKGROUND**

The m-health arena has started from a replacement market. Here Apps are administrative systems where the end-user is logging available data as provided from other sources. Examples are body temperature from a thermometer, calories from the food wrapper and body weight from bathroom scales. Such products do not provide more than a simple agenda for logging and many products share a lack of enthusiasm in the market.

The arena is growing in interest. Here electronic devices are integrated into common products, like bracelets, plasters and chains to provide single measurements on the body. A number of them still require additional handling. For instance, the usual glucose meter requires a blood sample to be taken and prepared for a special portable device. There is a tendency to become less invasive using intraperitoneal sensing (vanDijk, 2015), but non-invasive would be even better. A nice example is the gradual miniaturization of the pulse oximeter, which has gradually decreased in size while moving from the hospital to the clinic, and which will likely become as common as the thermometer in the very near future.

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