WEARABLE TECHNOLOGY
Putting the patient at the center of healthcare
FIND OUT MORE
WHAT WEARABLE TECHNOLOGY MEANS FOR THE EMPOWERED PATIENT

DE-SKILLED TEST KITS PROVIDE QUICK AND EASY DIAGNOSIS

MONITORING FOR HEALTHIER LIFESTYLES

CLOUD DATA ANALYSIS

DATA TO PATIENT OR CARER IN REAL TIME

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Healthcare is in the middle of a revolution

The pressures on healthcare are well documented. Rising demand is fueled by changing demographics, unhealthy lifestyles (leading to a greater prevalence of chronic conditions) and rising public expectations. These demands have led to significant economic pressures. Every health system in the developed world faces cost pressures, with the US looking at annual increases of 1.2% of GDP for the foreseeable future. In practice, healthcare will become unaffordable unless new ways of working can be found.

While change in healthcare takes place very slowly, it is recognized that the introduction of new technology will play a crucial role in keeping it affordable. In particular, technology can address many of the challenges raised by longer life expectancy and people living with chronic conditions.

As both of these conditions are exacerbated by unhealthy lifestyles, healthcare providers can use technology to gently coach people into improving their diet, reducing their alcohol and substance misuse and taking their medicines correctly. This presents a great opportunity to improve patient’s behavior without encountering the accusations of ‘big brother’ that have sometimes come up for similar initiatives in the past.

Yet the success of recent drives to use technology in such a way – including the application of telehealth for the management of patients with chronic conditions – has been patchy. In the US, the Affordable Care Act is set to radically increase telehealth spending to $1.9 billion by 2018 from the $240 million spent in 2013. This will help to offset the shortage of doctors the US is currently facing.
Telehealth and the need for ‘something special’

It could be argued that it is not telehealth in principle that is the problem, but the supporting technology – and how it is applied – that has limited its success. A rift has appeared between what consumers expect and want from technology, and what health and social care providers are offering. Indeed, we could ask whether current telehealth technology will go the way of the Amstrad Superphone. Launched in 2004 to provide video calling and web-browsing on one device, the Superphone was a good idea in theory but suffered because it was launched when similar capabilities were becoming available through more user-friendly smartphones.

Similarly, today’s telehealth technology could be said to lack the ‘something special’ that consumers have come to expect from their personal devices. As a result, telehealth still does not make practical sense for all stakeholders and thus does not always provide a continuous view of a patient’s condition.

The importance of constant monitoring

The principle of constant monitoring is a part of modern life. When we look at expensive equipment and machinery today, we see integral monitoring systems that provide advance warning of problems. The modern car, for example, has over 100 different systems, from the humble fuel gauge to tire-pressure warning systems, up to more cutting edge lane positioning systems. Each of these is constantly gathering data to identify when preventative maintenance or changing driving behavior is beneficial. Early intervention to nip potential problems in the bud, or to prevent damaging behavior, improves experience and reduces cost of ownership.

If we monitor our cars to this degree, why would we not monitor our health in the same way now that it is increasingly feasible to do so?

The next big thing?

Today, many commentators suggest that wearable technology will enable the successful implementation of telehealth. Widely advertised as the next big thing, roughly one out of every six Americans already use some form of wearable technology and many of these are wellness or health-related devices such as heart rate and activity monitors.

Technology advances – including miniaturization, enhanced connectivity, improved usability, reduced cost, increased reliability and battery life – explain why industry leaders expect wearable technology to become ubiquitous. We are also expecting battery life to improve further, and for exciting new possibilities to come on stream including technologies that allow energy to be harvested from the environment, body heat or movement.

Already, over 300 companies are devoted to ‘digital health’ and there has been a massive rise in those displaying wearable technology. In addition, Transparency Market Research estimates that the market was worth $750 million in 2012, growing at a Compound Annual Growth rate (CAGR) of 40% to $5.8 billion in 2018. Over $2 billion of this will be health and wellness related.

So it is clear that wearable technology holds a great deal of potential for healthcare. But how can the sector ensure it is deriving the greatest possible benefit?

First of all, we need to be clear on how the application of wearable technology can and will make a difference to healthcare.
Engaging patients in healthcare to save billions each year

In our view, wearable technology should be placed right at the front of the patient pathway, where it can be used to support a much-neglected prevention agenda.

By helping people lead healthier lives, manage chronic conditions and improve access to care, wearable technology can play a key role in reducing the primary care bill. As healthcare spending rises, hitting $2.7 trillion in 2013, any technology that engages patients and helps them manage their own symptoms can make a significant difference.

For example, by applying wearable technology to the front of the care pathway, and focusing on the right patient cohorts, we could save billions in primary care costs every year based on reductions in primary care appointments. This would have additional knock-on benefits, including improvements in quality of care further down the patient pathway and reduced admissions and bedstays. In fact, mHealth technologies is estimated to decrease spending in treating chronic conditions by 35%, one of the highest areas of spend in US healthcare. Even with the costs of the technology, the potential to save between 7% of primary care costs and 10% of acute care costs makes it one of the most promising solutions in healthcare today.

In practice, we believe wearable technology can achieve these benefits by:

- **Acting as a digital coach**
  Influencing and coaching people to manage their own health

- **Constant but less obtrusive diagnosis and monitoring**
  Helping those already diagnosed with chronic conditions optimize their lifestyles and avoid unnecessary visits to the hospital

- **Improving access and experience**
  Helping patients navigate through the health system
Promoting healthier lifestyles

The subtle use of technology can keep healthy living at the forefront of people’s minds and support them in changing their behavior to achieve a better lifestyle.

The consumer product sector has sown the seeds and created the demand for wearable technologies. These companies are leading the way in ‘nudging’ – driving behavioral change in customers through successful incorporation of wearable technologies.

Who would have imagined that we would demand products such as personalized miniature sound amplifiers to increase our hearing, or headphones inside a headband to coach us into better sleep? These ‘created demands’ have successfully changed our consumer realities. By creating a self-fulfilling prophecy, the industry has trained us to demand more tech-savvy product solutions by offering them to us.

In recognition of this success, the healthcare sector needs to make use of the playing field that the consumer sector has created. By fostering consumers’ growing acceptance of, and demand for, wearable technologies, the sector has paved the way for wearable technologies to support healthier lifestyles. Banking on the principle of the self-fulfilling prophecy, and adapting ‘nudging’ to its own ends, the sector could use wearable technologies to propel itself into a new era.

Encouraging a positive change in lifestyle

As consumer product companies use wearable technologies to connect to the consumer, healthcare companies can use them to motivate people into adopting a healthier lifestyle. Helping people comply with drug delivery regimes and adhere to correct physiotherapy techniques are two examples of how wearable technologies can meet the needs of the user and the industry in this area.

Compliance with drug delivery regimes is often described as the ‘holy grail’ of the healthcare sector. At present, poor compliance is understood to cause around 3% of global healthcare expenditure, which equates to $165 billion per year.
Smart pill technology

Smart pill technology – where a wearable sensor acts as a communication hub between the ingested product and a mobile phone – is on the cusp of becoming a reality. We are seeing companies entering the market with ingestible sensors that run on the electrical charge found naturally in the human body. This gives a new dimension to the compliance challenge. Although day-to-day user numbers are still low, the prospect of being able to confirm that a specific pill, tablet or other product has been ingested is upon us. As a result, patients, carers and clinicians can use real-time information about medicine doses – combined with activity and rest data – to make informed, collaborative treatment decisions. Remote monitoring also gives carers a level of comfort when they aren’t able to be present with their loved ones.

In addition to bringing a whole new dimension to compliance and treatment, smart pills and sensors have the capacity to provide data that will help researchers gain a higher level of understanding of diseases than is currently possible in clinical trials. Continuous and long-term data collection from large numbers of patients could help uncover new insights in many long-term chronic conditions.

The phrase ‘digital coach’ may sound too directional to some, but it may help to think of the application of wearable technology as being more about life than sickness or health. It can provide an answer to the implicit question, ‘What do I want to accomplish in my everyday life?’
UNOBTRUSIVE DIAGNOSIS & MONITORING
Diagnosis within healthcare is often based on the patient recounting events, describing symptoms or taking samples or scans that describe the condition at one instant in time. In the past, sensors for capturing data from patients have been cumbersome to the extent that they can only be used for set tests. Unobtrusive sensors connected to the internet, however, provide the opportunity to collect data on conditions over a long period of time and give doctors much richer information about trends, perturbations and cycles to help them make their clinical decisions.

Sensors can also be used to monitor long-term conditions. Adoption of telehealth has been patchy across different health systems in the world but the potential for wearable telehealth provides a catalyst for really driving out the benefits. To illustrate this, we provide the following scenarios.

- Keeping dementia sufferers safe
- Maintaining independence for patients with complex needs

7.7 MILLION NEW CASES OF DEMENTIA EACH YEAR

IN 2013
44.4m WERE SUFFERING FROM DEMENTIA

IN 2030
75.6m PEOPLE WILL HAVE DEMENTIA

IN 2050
135.5m PEOPLE WILL HAVE DEMENTIA
Keeping dementia sufferers safe

Dementia and related conditions present a huge economic and social burden. There are 7.7 million new cases of dementia each year and there is a new case somewhere in the world every four seconds. In 2013, there were 44.4 million people worldwide with dementia and this number is expected to grow to 75.6 million by 2030, and 135.5 million by 2050. Spend on dementia care currently represents 1% of global GDP even though it is estimated that 75% of cases still go undiagnosed.

Today, there are no drugs that can cure dementia, only slow the disease progression. The first set of biomarker diagnostics, to indicate the disease state, are on their way but are several years from market entry. The economic and social burden of dementia is primarily on the patient and the immediate caregiver, but it is clear that technology can be used to assist in the care of the patient and support caregivers’ needs.

Drug adherence is frequently cited as an unmet need by clinicians but patients don’t see the benefit as the drugs aren’t effective enough. Technology such as smart pills and drug-use sensors can provide adherence data and also detect overdosing, providing information to support prescribing. However, this is not the primary benefit of technology in dementia care.

Patients and caregivers want to make the most of the time they have together and they are increasingly remote to their loved ones. Caregiver guilt and their need to remain economically active can be at odds but technology can help with GPS, actigraphy, 3D-giroscopes, GSM and body sensors.

Body-worn devices on the patient can provide information on patient safety, activity, falls, body and ambient temperature and location as well as providing alert response mechanisms. These devices can also be waterproof and continue to operate during bathing and swimming. The technology is available today in sports watches (Garmin), activity monitors (Nike Fuel Band) and mobile phones.

Algorithms using data from body wearable devices can also be used to assess gait – fast becoming a key to unlocking the progress of disease – and this information can be shared with caregivers and clinicians to assess how best to support the patient.

Resulting data from devices and supporting services can be used to unlock some of the mysteries of the disease. Phenomena such as sun-downing (increased restlessness at the end of the day), seasonal influences and behavior patterns are hidden from researchers and clinicians outside of small studies or clinical trials, but data from a large number of dementia sufferers and their environment could reveal new insights.

While we look for a cure for the millions of dementia sufferers, patients and caregivers will hugely benefit from the wearable technology available on our doorstep today.
Maintaining independence for patients with complex needs - a fictional scenario

Doreen picks up the phone. It’s a call from her nurse Claire: “Hi Doreen, I need to change your bandage today – will you be in if I visit at about 11?” Doreen wears a smart pressure bandage on an ulcer on her leg and the bandage has sensors to ensure it is applied with the right tension. It also continuously monitors how the wound is healing, sensing heat, moisture, heart rate and activity. Today it has picked up a sign of a potential infection and forwarded an automatic alert to Claire.

Doreen is 89 years old and has advanced-stage heart disease. She was diagnosed with diabetes two years ago and now suffers from macular degeneration. She also recently had a series of bumps and falls which have left her with some persistent injuries on her leg. Nevertheless, she can still live with her younger sister Lizzy.

Doreen chats to Claire when she visits: “I’ve had a good life, and I’m really glad I can live at home. I couldn’t bear leaving Lizzy on her own.”

Lizzy is worried about Doreen’s falls, and is really pleased that the smart bandage includes a sensor that recently detected a fall. Lizzy was woken by a call from the monitoring center, and was able to comfort Doreen while they waited for a home health aide to visit to help get her back on her feet.

Claire opens her tablet and pulls up Doreen’s record: “Now that I’m here, let’s have a quick look at how you are doing. I can see you’ve gotten back into a regular pattern of sleeping and you are spending more time out of bed during the day.”

Doreen tells Claire that she is really pleased with her smart glasses. She doesn’t like wearing them all the time, but with her failing eyesight she has found they really help her find things in the kitchen so she can still prepare herself a meal.

Just as she is saying that, Lizzy comes in: “I think the glasses are great too. I put them on to guide me through Doreen’s medication regime. They tell me that I have the right pill box and instruct me how many to give her. I wasn’t sure I wanted to get involved in her insulin injections, but the glasses help me find the right spot and tell me what to do.”

The real payback in managing long-term conditions through wearable technology is the avoidance of an acute episode, which is bad for the patient and costly for the system. Wearable technology that recognizes when something is going wrong is a real step forward. Its convenience makes constant monitoring possible, which minimizes the chance that the warning signs are missed.
BETTER ACCESS & EXPERIENCE
Industry efforts to redesign healthcare facilities around patients is often hampered by the existing estate, the cost of changing buildings and other factors such as hygiene and clinical dependencies. Wearable technology already exists to enable people to navigate around unfamiliar warehouses and these point to applications which would allow patients to find their way more easily around a network of health buildings.

If we extend the use of wearable technology from patients to staff within a hospital, we see opportunities for efficiency improvement. The same technology that can make warehouse work more efficient can help staff find specific equipment, ensure they are where they need to be, locate the right documents and even find the right patient to take down to surgery.

Language is often a barrier but wearable technology offers a solution. For example, the use of a heads-up display device such as Google Glass or Vuzix to turn sign language into voice can enable any doctor to communicate with deaf people.

Learnings from eHealth

There is a broad consensus that eHealth - the use of IT to deliver healthcare - has the potential to drive significant improvements in the way healthcare is provided, making high-quality care more accessible and affordable.

The real opportunities come not just by improving the efficiency of care delivery but also from using IT to enable a transformation in the process of healthcare. Information will allow a better assessment of the quality of outcomes, enabling a shift in incentives and focus – from delivery to prevention and promotion. Yet, despite this clear promise, many eHealth initiatives continue to fall short of their early promise. When looking at the potential challenges around adopting wearable technologies, it is therefore helpful to learn from recent attempts to promote eHealth.
Our experience in this area suggests that there are three important aspects to get right when shaping programs for large-scale adoption of wearable technologies:

**Using achievable objectives to drive benefit realization**

Early adoption will be more successful when the wearable technology has an immediate benefits case. In consumer markets, this can be an aspirational or emotional case, which also needs to be mindful of price and expectations around acceptance by care professionals. Where reimbursement comes from insurers or governments, there is a need to demonstrate a clear early return on investment as well as alignment with health reform ambitions.

**Focusing on enabling a wider ecosystem**

Wearable technology is part of a wider ecosystem with health information exchanges and clinical records systems. Many innovators in health technology have found that the addressable segment is only a tiny fraction of the potential market because of the cost and difficulty in entering local ecosystems. While proprietary technologies have made medical technology markets lucrative, and have been central to the regulatory regime, an ecosystem with internationally accepted open technical standards is essential for large-scale adoption.

**Taking people with you over privacy concerns**

The use of information from wearable technologies to drive the quality and effectiveness of care brings into focus the tension between accessibility of data and protection of privacy. Our experience suggests that it is possible to identify a middle ground. In moving towards large-scale adoption, it is important to recognize the limits of ‘opt-in’ consent models and design systems that align with the views of the substantial majority. It is also important to recognize the rights of some to opt out and establish effective governance to provide confidence in the information-sharing mechanisms.
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We are experts in energy, financial services, life sciences and healthcare, manufacturing, government and public services, defence and security, telecommunications, transport and logistics.

Our deep industry knowledge together with skills in management consulting, technology and innovation allows us to challenge conventional thinking and deliver exceptional results with lasting impact.