Transforming primary care
Health Care First Partnership CEO Jyoti Mehan on crisis, turnaround and opportunities in primary care

Gatekeeper to gateway
Growing demand for private GP services could benefit the whole private sector

Keeping it civil
Dr Lynne McKinlay of MPS Partnerships looks at reducing medicolegal action

MAY 2022 | VOLUME 26 | ISSUE 4

HM UK HealthcareMarkets

Independent. Intelligent. Insightful.

In depth

Help at hand

Wearables have given us the ability to monitor our fitness in real time, but will 'implantables' mark a step-change in the commercialisation of health data?

Microchip implants remain a long way from the mainstream but the technology is already moving beyond key fobs and contactless payments to health monitoring and medical records, with potentially huge implications for clinical practice. Candesic's **Dr Joe Taylor** takes a personal journey through the emerging world of 'implantables'

Your health in **your** hands

The idea that technologies we see in science fiction today will become everyday essentials tomorrow is the norm for most digital natives. However, there are always a few inpatient souls for whom tomorrow cannot come fast enough. Enter the biohackers. From blockchain billionaires to unassuming actuaries, there are increasing numbers of people who, through their own design, are more than meets the eye.

Most of us have become accustomed to smartphones and watches that monitor our movements and help track our fitness goals. But now, naked as the day we were born, our hardware is becoming skin deep. And implantable Near-Field Communication (NFC) communication could fundamentally change our approach to healthcare.

Having rejected the cards dealt by legacy NFC, biohackers have implanted chips in their bodies to explore the potential of a few kilobytes of unlosable, incorruptible, and unforgettable data. Do not imagine a future shaped by rooms full of whirling servers in the icy enclaves of faraway lands. It takes just 56 bits of information stored in a capsule a little larger than a grain of rice to open more than just your office door. Implantable NFC devices are finding their niche, and as usual, the pioneers have found a home for this technology in healthcare.

The range of options currently available on the market is varied and the number is increasing. Some implantables have specific dedicated functions while others are self-programmable chips.

To some, this might seem strange or unsafe, but I have both types implanted in my hands. My dedicated chip, Walletmor, enables me to make contactless payments just as I would with a contactless payment card. Anyone can buy the implant kit from Walletmor, which will also recommend a competent installer. However, more fun than my payment chip are my VivoKey chips, which enable me to explore their healthcare potential.

What is an NFC chip and how does it work?

NFC is a set of communication protocols enabling two electrical devices to share information over short distances (less than 4cm). It differs from the Radio Frequency Identification (RFID) chips which enable only one-way communication. RFID chips have an unchangeable

unique identifier and potentially a small data set, while NFC chips can also be re-written. I have both.

There is very little information either chip type can hold (about 8Kb). If the only function required is as a unique identifier, for example, to unlock an NFC/RFID enabled door lock then effectively everything that is required to fulfil that function is stored on the chip.

Most access cards used in office blocks are not very secure so you can clone the card information to an NFC chip and never get told off by your block's receptionist for losing another key card again! However, the real utility of the data held by a chip is in offloading the interesting data or programme to the cloud or web – directing the detection device to a chosen URL or opening the required application.

RFID and NFC technologies have been around for a very long time and are already part of our everyday lives. The only difference with an implant is that it sits under your skin rather than in your wallet. Consequently, the implants can tap into the existing vast ecosystem of RFID/NFC enabled hardware.

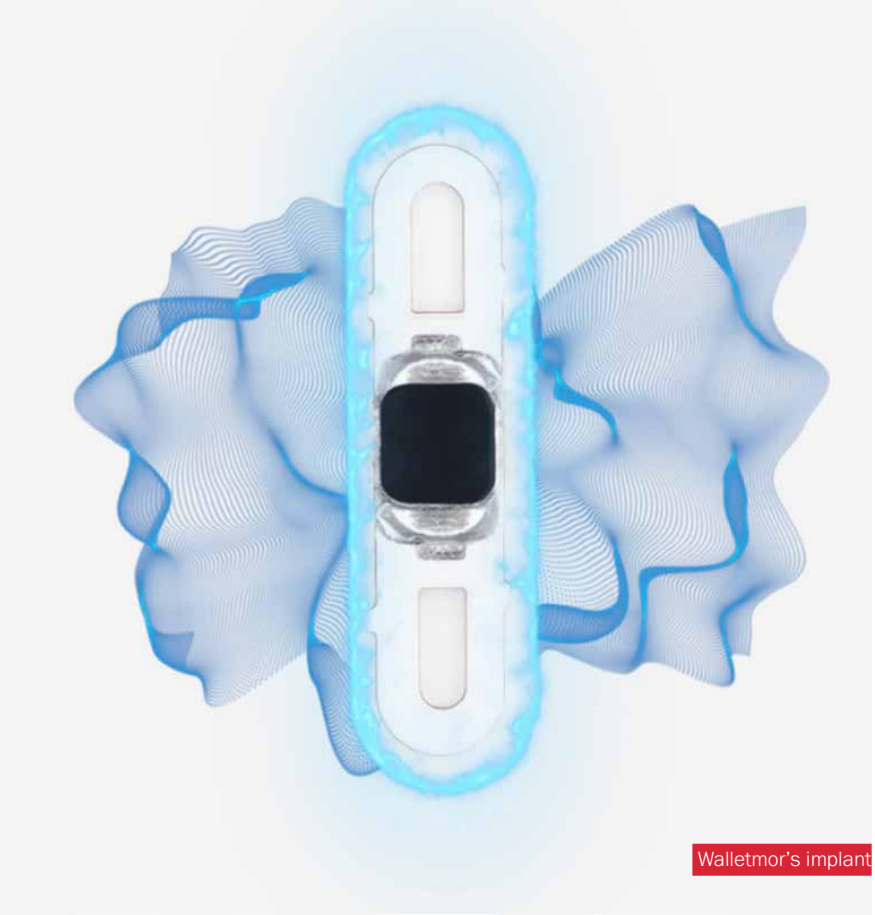
The chips themselves vary in size and form, from cylindrical shapes about the size of a couple of grains of rice, to flatform chips 20mm long and wafer-thin. Most can be inserted without much complexity and the need for local anaesthetic (see Figure One). They use energy delivered by the receiver and therefore require no batteries and should last a lifetime.

For most current functions, it's convenient to insert the chips into your hands and there is a nice bit of tissue between your thumb and first finger that provides plenty of room. It also has the added benefit of trapping the chip in this anatomical triangle, so you don't have to go searching for it around your hand when you want to scan it (see Figure Two).

Once implanted, most chips can be felt through the skin and can move within the anatomical boundaries of the implantation site. I do not notice mine at all, but it is quite fun to show people.

In contrast to Vivochips, which come with an automated implantation device, the WalletMor chip is delivered via an incision tool.

Although rather intimidating, this allows a pocket to be created underneath the skin into which the chip can be slipped with relatively little pain in the absence of anaesthetic.



Walletmor's implant

How can implantables support doctors in an emergency?

The 'effortless identity' that can be supported by carrying your keys and wallet in a chip between your thumb and middle finger is now moving into effortless access to vital medical records.

Verichip is an implantable RFID approved by the US Food and Drug Administration (FDA) for the identification of patients. The chip contains a link to a secure database through which the patient's medical records can be accessed.

If a patient is delivered to A&E unconscious or after a severe accident rendering them unable to communicate, with no identification, doctors will no longer have to waste precious time locating their medical records. A Verichip enables doctors and nurses instant access to patient notes. This could also be helpful in cases of severe autism, learning difficulties or dementia when the patient is unable to relay their identifiable information.

Despite the obvious benefits of Verichip and similar devices, there are concerns over privacy. However, by providing a link to a secure database for which doctors or other healthcare providers require a password, this is effectively no different to how patient information is stored on computers.

For those less concerned about who has access to key medical information, people can use a solution such as VivoKey to direct anyone scanning the chip to a website of their choice, where they can upload the records they want to share. This is similar to wearing a medical alert bracelet. These are visible to anyone who can see your wrist just as a chip is readable by anyone who in close proximity to your hand.

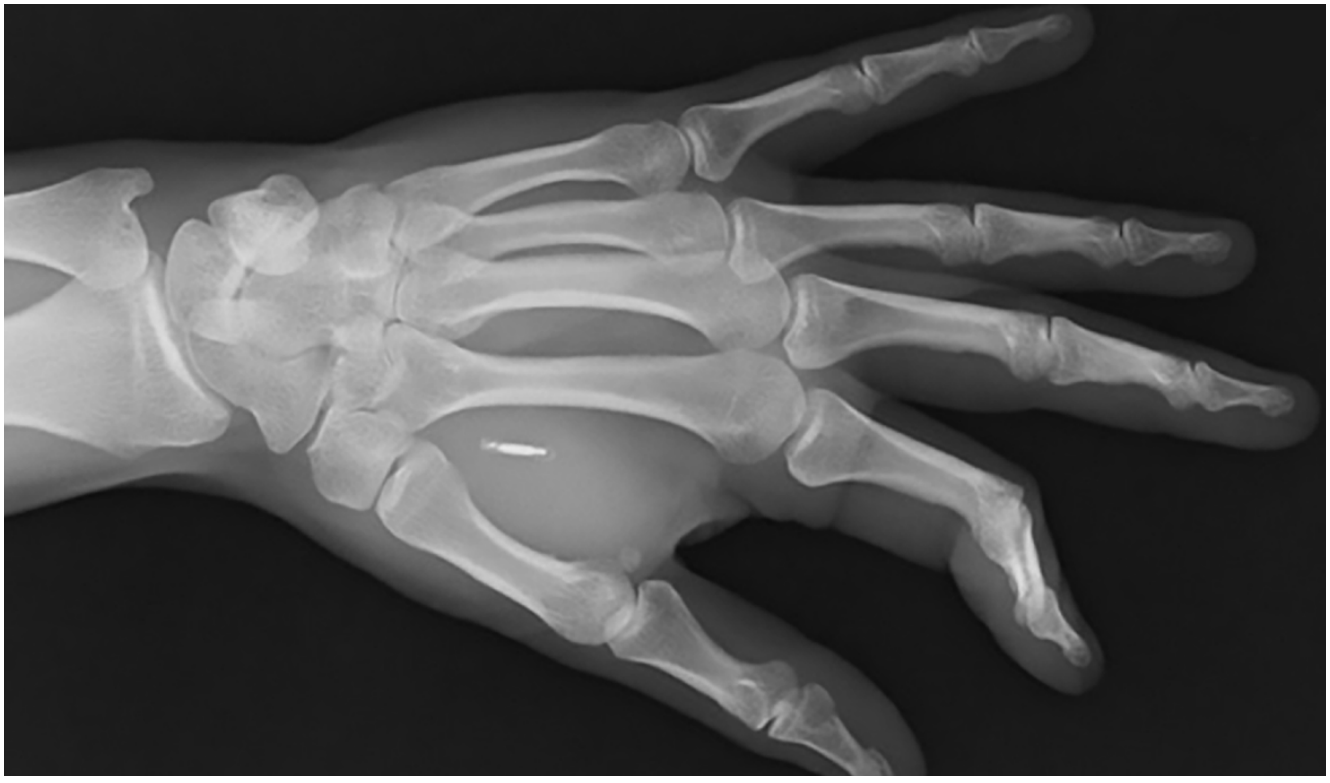
Body temperature monitoring

Imagine for a second that everyone was fitted with a device which could continuously monitor body temperature. It is not hard to think that Covid-19 might have taken a different trajectory. Everyone would have

FIGURE ONE
HERE I INSERT A CHIP INTO A FRIEND'S HAND ON MY DINING ROOM TABLE

SOURCE CANDESIC RESEARCH

FIGURE TWO
X-RAY OF A CHIPPED HAND



SOURCE CANDESIC RESEARCH

been aware of their rising temperature straight away and could have isolated. Governments could also have obtained accurate, up-to-date, and easily processable epidemiological data about where outbreaks were occurring and planned accordingly.

In 2013, Tim Cannon the co-founder of Grindhouse Wetware had a bulky Circadia 1.0 implanted into his forearm which could monitor his body temperature. The same technologies still exist but thankfully are now much smaller. LifeChip is an RFID chip intended for animals while Swedish start-up DSRuptive is in clinical trials to demonstrate the ability of its implantable to monitor body temperature. Crucially, this is a robust trial with early published results demonstrating efficacy.

Blood test implant

In Lausanne, Switzerland, the Federal Institute of Technology has developed an implantable device which can be used for personal blood testing, namely monitoring lactate, glucose and ATP, which it hopes will become commercially available in the next few years.

The information gathered is sent via Bluetooth to a patch worn by the patient, which can then be sent directly to doctors through cellular networks. Potentially, this could reduce the need for GP check-ups and enable people to take ownership of their health.

In 2018, the CEO of Three Square Market, a Wisconsin-based company, said it was working on a voice-activated, body-heat-powered chip which can monitor a person's vital signs and track them via GPS.

Improved IVF outcomes

Impli is a London-based company using implanted medical records as a means of 'democratising' medical data and ensuring everyone has ownership over their medical records. However, its principal objective is deployment of an implantable which frequently measures Oestradiol, Progesterone and Luteinizing Hormone to enable improved timing of embryo implantation in IVF.

Incumbent disruption

As is necessary for the constant churn of human advancement, old incumbent technologies need disrupting with innovation. We have seen plenty of examples of incumbent technologies such as intermittent capillary blood measurements (for glucose levels) or intermittent thermometer measurements, but there are now disrupting technologies in implantable chips which can monitor and measure continuously.

Junior doctors may forget to order a blood gas or blood culture, a diabetic may forget to measure their blood glucose level, administer their insulin, or administer the incorrect dose – causing potentially dangerous hypoglycaemia. By automating these procedures with internal technologies, human error is removed and doctors' time freed up to focus on important decisions regarding patient care. This last point is becoming more significant in an NHS where doctors are increasingly overstretched for time and resources.

> AS IS NECESSARY FOR THE CONSTANT CHURN OF HUMAN ADVANCEMENT, OLD INCUMBENT TECHNOLOGIES NEED DISRUPTING WITH INNOVATION

How are implantables regulated?

As new implantable technologies are developed and adoption increases, legal frameworks will be required to ensure appropriate regulation of products and safety of those using them.

The categorisation of these technologies will be important as it determines how they are regulated. This can be a surprisingly difficult thing to decide. For example, toothpaste could be classed as a drug as it contains fluoride - a cosmetic that whitens teeth, or a medical device as it uses abrasive action to protect your teeth.

Currently, most implantable NFC technologies are not categorised by the Medicines and Healthcare products Regulatory Agency (MHRA) as medical devices. This means the regulation is limited and they do not have to be implanted by a registered medical professional. In essence, they are treated in the same way as a skin piercing.

This causes obvious risks as well as raises ethical questions about who is responsible for potential harm caused to those with these implantable technologies. However, this lack of regulation has also enabled biohackers to experiment and innovate.

Making implantables mainstream

Payment technologies have become a key driver for wearable device adoption, from watches to payment rings - including the K ring - which I have been using for more than a year.

For years it has been possible to coat the surface of the chip from a standard credit card in a bioinert polymer and implant it, and yet a dedicated payment chip has only just entered the market. Walletmor is a €200 implant which links to an iCard account, an EU-based digital wallet, which allows for contactless payment. Launched in 2021, (my most recent implant), it offers a genuine everyday use case for NFC implants.

These everyday applications are likely to be important in changing people's attitudes to having chips implanted for healthcare reasons.

Implantable chips are likely to become an increasing part of healthcare monitoring and data communication, both in good health and in disease.

While today I am unusual in having implanted NFC and RFID chips, I predict that they will quickly lose their novelty as more people recognise the benefits and their application becomes more prolific and widely understood.

The K ring