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Connected health

How digital technology is transforming health and social care

Deloitte Centre
for Health Solutions

Contents

The Deloitte Centre for Health Solutions

The Deloitte Centre for Health Solutions, part of Deloitte UK, generates insights and thought leadership based on the key trends, challenges and opportunities within the healthcare and life sciences industry. Working closely with other centres in the Deloitte network, including the US Center for Health Solutions, our team of researchers develop ideas, innovations and insights that encourage collaboration across the health value chain, connecting the public and private sectors, health providers and purchasers, and consumers and suppliers.

Foreword

Welcome to the Deloitte Centre for Health Solutions report *Connected health: How digital technology is transforming health and social care*.

Connected health or technology enabled care (TEC) is the collective term for telecare, telehealth, telemedicine, mHealth, digital health and eHealth services. TEC involves the convergence of health technology, digital, media and mobile telecommunications and is increasingly seen as an integral part of the solution to many of the challenges facing the health, social care and wellness sectors, especially in enabling more effective integration of care.

TEC seeks to improve people's ability to self-manage their health and wellbeing, alert healthcare professionals to changes in their condition and support medication adherence. For health and social care providers, it can help deliver safer, more efficient and cost-effective care.

Digital technology is advancing exponentially and its cost is plummeting. At the same time the demand for and cost of healthcare is rising, which is challenging most health economies across the world. The need to adopt technology to help meet these challenges seems obvious, but healthcare continues to lag behind other industries in using technology with service users, in this case, patients and carers.

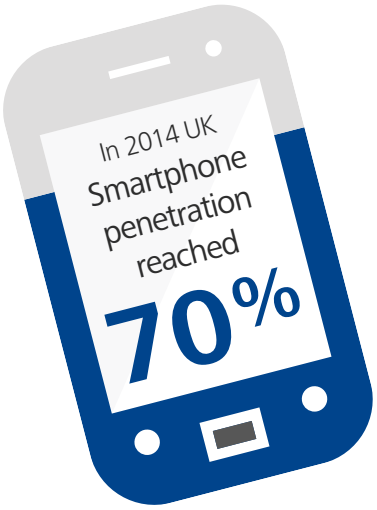
This report analyses opportunities and barriers to the adoption of TEC based on extensive literature reviews, discussions with stakeholders and our work with commissioners, providers and technology companies. It focusses on the United Kingdom market but in a global context drawing on examples of good practice from the UK and other countries, including the United States, where many healthcare providers lead the field in their adoption of digital technology.

The report considers the barriers to adoption, shifting dynamics between patients and clinicians, and how technology can help providers to work differently. The intention is to provoke discussion and offer readers examples of solutions that may fit their situation.

The task now is for healthcare providers, commissioners and payers across the UK to adopt TEC at scale and we hope this report provides a useful stimulus for doing so. As ever we welcome your feedback and comments.

Karen Taylor
Director, Centre for Health Solutions

Technology is becoming more pervasive



Top pharma companies have

63% more

unique apps in 2014 vs. 2013

Need for cost effective healthcare is increasing

2020-2021 NHS funding gap forecast to reach

£30 billion

Rise in chronic conditions expected to cost

£5 billion per year

by 2018

Care home residents are 40-50% more likely to have an emergency admission / A&E attendance than **the general population of over 75s**

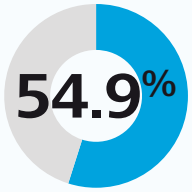
Significant mHealth market growth predicted

Global revenues

2013
mHealth valued at
$2.4 billion

2018
Forecast to reach
$21.5 billion

Growth per year of



European revenues

By 2018 Europe will be the largest mHealth market worth

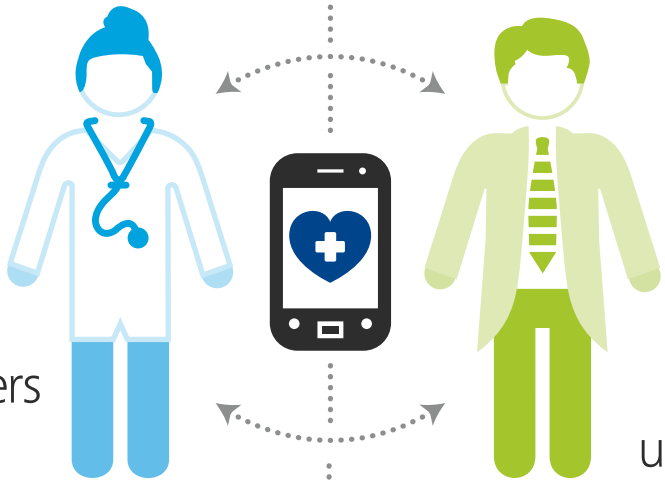
$7.1 billion

With the highest predicted growth per year at

61.6%

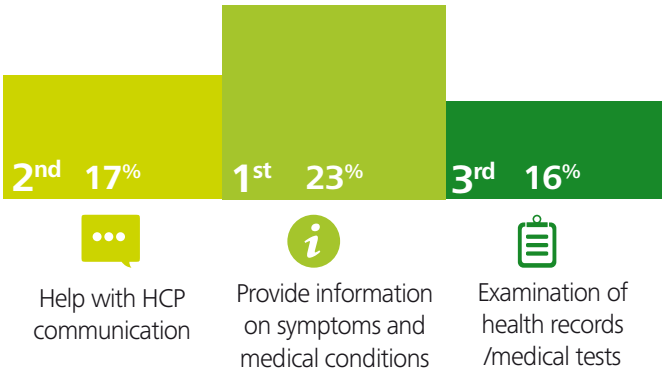
Health provider view

Patient view



Benefits of digital health for providers

Patients single most important use of health apps



Factors that increase the use of health apps:

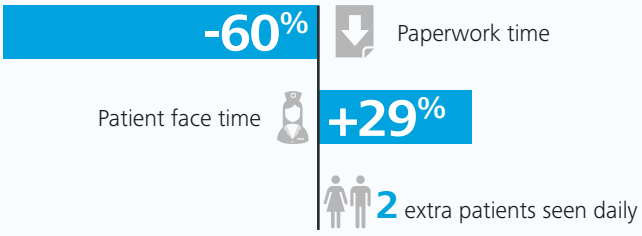
Trustworthy, accurate data: 69%

Ease of use, simplicity and design: 66%

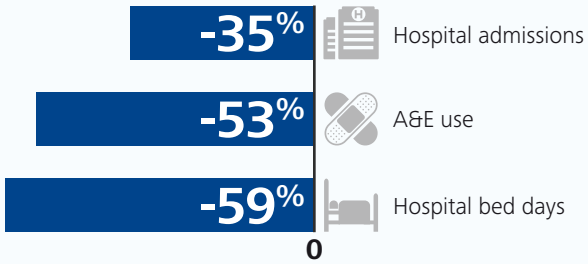
Guarantee of data security: 62%

Evidence of health technology benefit for providers

A mobile working solution for community nurses



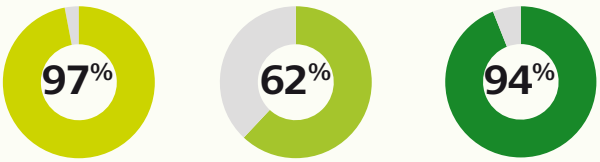
A telehealth hub across 210 care homes



Evidence of health technology benefit for patients

75% of the UK population goes online for health information

Patients using technology to manage their COPD:



Executive summary

This report provides a current review of the ways in which digital technology is changing health and social care delivery, with an emphasis on the UK.

Connected health, also known as technology-enabled care (TEC), involves the convergence of health technology, digital media and mobile devices. It enables patients, carers and healthcare professionals (HCPs) to access data and information more easily and improve the quality and outcomes of both health and social care.

TEC is capable of providing cost-effective solutions at a time when the demands on health and social care services continue to increase due to the UK's growing and ageing population, the rising costs of advanced medical treatments, and severely constrained health and social care budgets. Indeed, wide scale adoption of TEC will be essential for sustaining the future health and social care system.

Opportunities for using mobile technology have improved in the last few years with the growing population of smartphone and tablet users in the UK, even among older age groups, supported by a proliferation of health apps, although only a few are currently being used extensively. Other notable developments are the availability of healthcare 'bio-sensing' wearables, such as digital blood pressure monitors and glucose sensors, and patient and provider access to real-time healthcare data and information. Additionally smartphones are incorporating a growing range of sensors which monitor changes in physiology.

However there are various barriers to the deployment of TEC: many of these were identified in a consultation exercise by the European Commission in 2014, with widespread concerns about issues such as quality, reliability, data overload, privacy and security. However, there are now fewer concerns about the cost-effectiveness of TEC due to the improving quality and reliability of devices and apps and the falling cost of digital technology.

A further problem is that TEC solutions have been technology-driven, often without the involvement of the people they are aimed at. HCPs are often reluctant to engage with technology, partly due to the scale and pace of changes, and partly through lack of education and training, and concerns over liability and funding.

Technology has the power to improve access to healthcare services, especially for people with mobility problems. This is recognised by the UK government, but there are concerns about inequality of access to the technology due to the cost and differences in broadband speeds. There are also challenges due to the lack of interoperable patient records.

In the past year, the UK governments have refreshed their digital health strategies. For example, NHS England established a National Information Board in 2014 to take forward the government's TEC strategy, with similar developments in the other devolved nations. Indeed, the integrated healthcare systems in Scotland and Northern Ireland have been at the forefront in exploiting TEC opportunities.

Mobile technology can empower patients and carers by giving them more control over their health and making them less dependent on HCPs for health information. They can use digital technology to research information online, share experiences and identify treatment options. Its use in providing access to information and education is an important driver of patient engagement. The most widely available health apps have been fitness, medical reference and wellness apps. While these apps provide information, many currently lack the functionality to do more in relation to health.

TEC is capable of providing cost-effective solutions at a time when the demands on health and social care services continue to increase.

The capabilities of apps and wearables are improving as a result of developments in technology. Other aspects of the growing uses of TEC are remote monitoring of changes in the health status of patients (home telehealth) and the use of digital messages to remind or alert patients to adhere to their long-term course of treatment or therapy.

Growth in the use of TEC has implications for healthcare providers. For example, there is increasing potential to support the shift of some 'hands on' treatment in primary care clinics and hospitals to home care via the use of digital communication such as e-visits, e-prescriptions and remote monitoring. There is enormous potential for further improvements across many aspects of health care provision – GP practices, residential and nursing homes and hospitals, and in particular areas such as mental health care – but only if the existing barriers can be overcome.

Developments are supported by the entry into the healthcare market by global technology companies such as Apple and Google, and by the involvement of pharmaceutical companies (which are among the most active publishers of health apps). Their involvement raises the possibility of new healthcare provider models and approaches to health research transforming the patient experience.

Innovations in science and technology today will transform healthcare tomorrow, in areas such as middleware, digital imaging and improved digital sensors. At the moment, the pace of change in the technology is increasing at an exponential rate, but the question remains whether developments will provide little more than hype for the healthcare industry, or whether they will truly transform care?

There is enormous potential for digital technology to improve many aspects of health and social care provision.

Part 1. Developments in technology enabled care services

Connected health or technology-enabled care (TEC) is the collective term for telecare, telehealth, telemedicine, mHealth, digital health and eHealth services. TEC involves the convergence of health technology, digital media and mobile devices and is increasingly seen as an integral part of the solution to many of the challenges facing the health, social care and wellness sectors, especially in enabling more effective integration of care. TEC uses connected, medical devices to deliver quality healthcare and includes software, such as health applications, and hardware including mobile diagnostics, remote monitoring devices and wearables.

The Deloitte Centre for Health Solutions' 2012 report, *Telecare and telehealth – a game changer for health and social care*, provided a synopsis of the evidence on the costs and benefits of traditional telecare and telehealth, explored the reasons for the limited adoption of this technology in the UK and identified solutions and international examples of good practice. The report excluded consideration of mobile or digital technology, given that adoption by healthcare providers was relatively nascent.[1]

Globally, there are cultural and regulatory barriers to the adoption of TEC, the extent of which varies from country to country. However, the increasing capability and decreasing costs of the technology means that financial barriers are becoming less of a concern. The focus of this report is on how developments in digital technology and associated devices can deliver TEC services and enable patients, carers and healthcare professionals (HCPs) to connect to information and data and improve quality and outcomes of health and social care. While the focus is on the UK, where relevant, it draws on examples of good practice from other countries, in particular the US.

How TEC can help tackle increasing demands on healthcare – today and tomorrow

In the UK, as in other parts of the world, population growth, increased longevity and more chronic conditions are increasing healthcare challenges.[2] Over a quarter of the UK population have a long term condition, and an increasing number have multiple conditions. People with long term conditions use a significant proportion of healthcare services (50 per cent of all GP appointments and 70 per cent of days spent in hospital beds), and their care absorbs 70 per cent of hospital and primary care budgets in England.

At a time of constrained health and social care budgets, the NHS in England is facing a £30 billion funding gap by 2020-21 with the anticipated rise in demand due to long term conditions alone, expected to require an additional £5 billion a year by 2018.[3]

The challenge for the future sustainability of healthcare systems is to find a balance between:

- constrained budgets and the rising costs of advanced medical treatments
- increasing complexity and costs of delivering care to an ageing, comorbid population
- increasing patient expectations and demand for better quality, patient-centred healthcare
- reduced availability and increased costs of HCPs, in-patient beds and residential care places.

There is a growing body of research showing that TEC, in particular mobile and digitally enabled technology, has the potential to reduce healthcare costs, increase access and improve outcomes.[4] The power and reach of the technology can improve access, overcome geographic distance and shortages of HCPs, while providing a more versatile and personalised approach to healthcare.

Use of mobile devices is increasing among all age groups

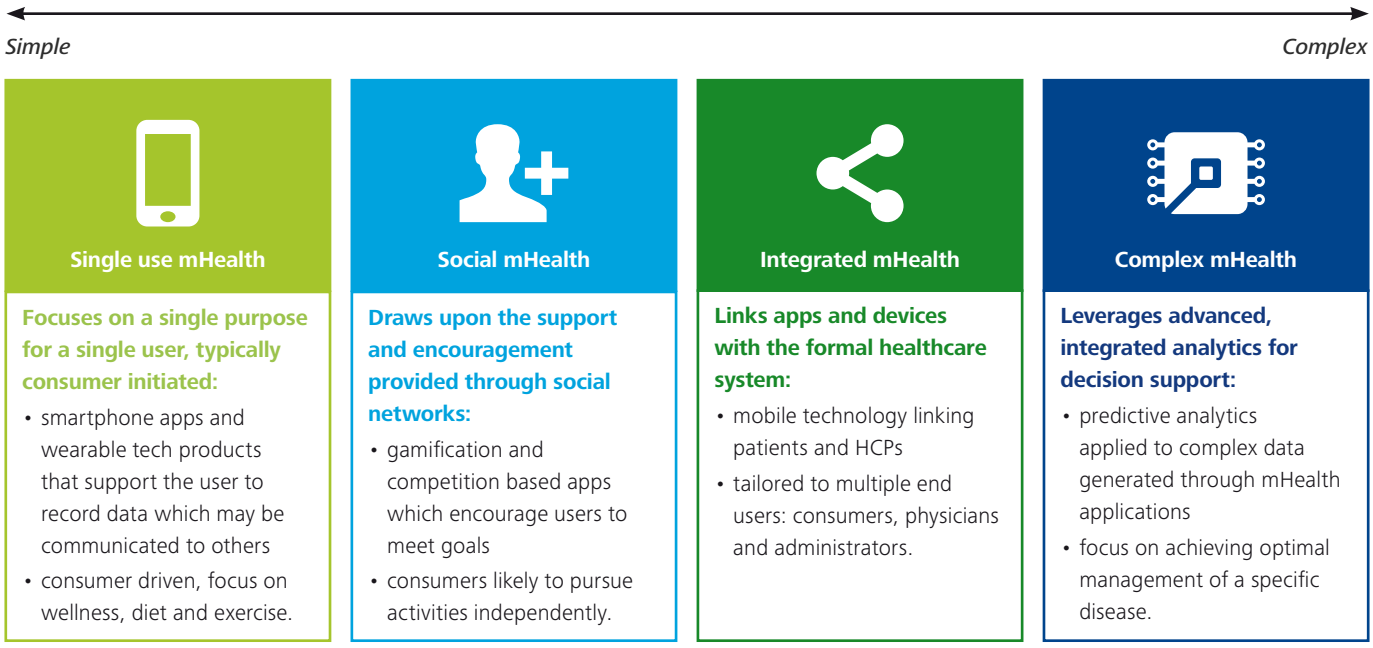
Although ownership of smart phones, tablets and other mobile devices is increasing rapidly, their use has lagged in older populations, who are the largest users of health and social care services. However, Deloitte's Telecommunications Media and Technology Predictions 2014 report suggests that the situation is changing and baby boomers (born 1946-1964) generated the fastest year-on-year growth in smartphone penetration in 2014.[5]

Smartphone owners are being encouraged to exercise, lose weight and improve the monitoring and management of their health, via an astounding array of mobile health applications (apps), including a growing number of medical health apps.[6]

Digital and mHealth opportunities range from simple to complex

Digital and mobile health (mHealth) have a wide range of uses, from chronic care management to complex population health analysis (Figure 1). As healthcare shifts towards a patient-centred, outcome-based delivery model, mHealth will be an important partner in healthcare transformation. The success of this partnership, however, will be the willingness of key stakeholders to embrace mHealth.[7] There is also a need for a robust business case to convince commissioners and providers that their involvement and investment in the technology is worthwhile.

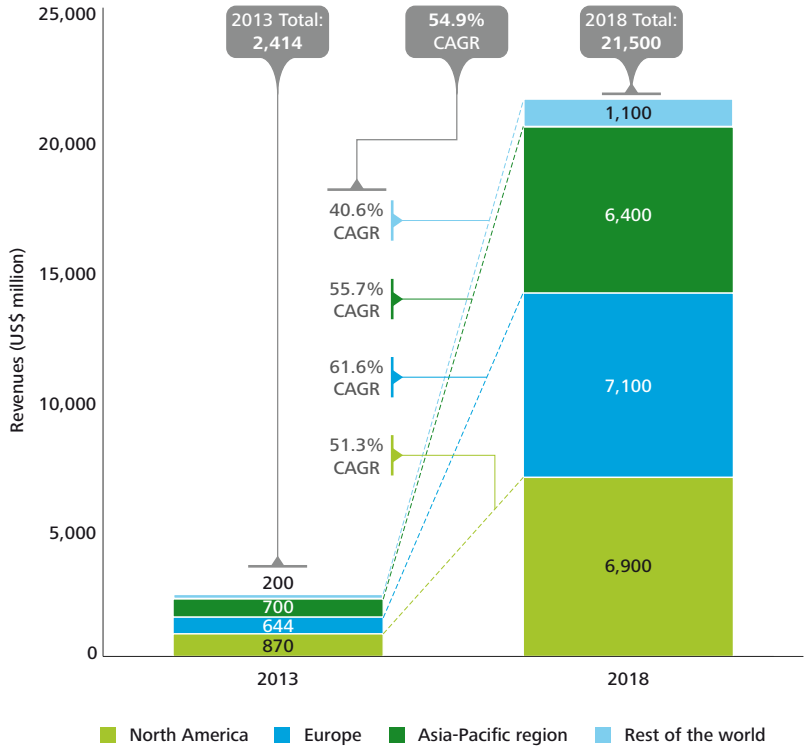
Figure 1. mHealth opportunities range from the simple to the complex



Source: Four Dimensions of Effective mHealth, Deloitte US Center for Health Solutions, 2014

TEC has the potential to reduce healthcare costs, increase access and improve outcomes.

Figure 2. Global mHealth market revenues, 2013-2018 (USD million)



Source: Mobile health technologies and global markets, BCC Research, 2014

The size and scale of the global mHealth market

There are four leading providers of mHealth technologies: mobile operators, device vendors, content developers and healthcare providers. The mHealth market is evolving at an increasing pace with many new entrants and incumbents developing a raft of new products and services. As a result, definitions of the market vary widely depending on the components that are included. While all industry forecasters are predicting significant growth, estimates of the extent of this growth vary extensively.

On the basis of estimates by BCC Research, covering connected medical devices, healthcare applications and related mobile technology, the value of the market in 2013 was $2.4 billion and is forecast to reach $21.5 billion by 2018, a compound annual growth rate of 54.9 per cent (Figure 2). By 2018, Europe is forecast to overtake North America as the biggest mHealth market, given the potential of the different healthcare systems to adopt, at scale, the technology that is currently used in relatively small pockets of the healthcare provider market.[8]

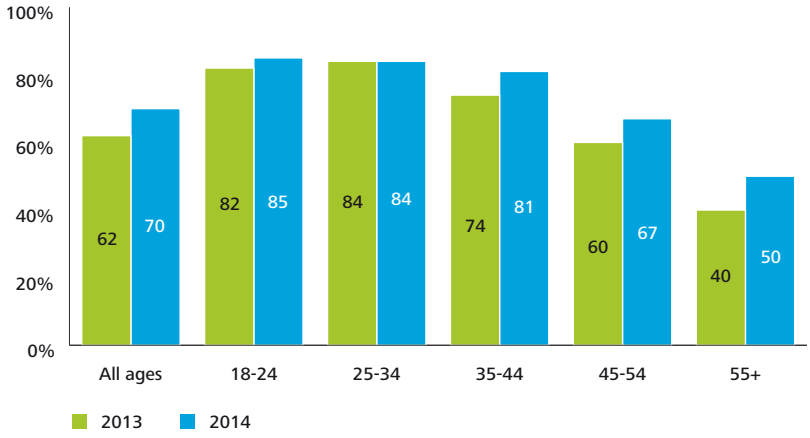
… the value of the mHealth market in 2013 was $2.4 billion and is forecast to reach $21.5 billion by 2018, a compound annual growth rate of 54.9 per cent.

The increasing prevalence of smartphones and apps

The number of health apps on the two leading platforms (iOS and Android), has more than doubled in less than three years to reach over 100,000.[9] This rise is being driven by the increasing ownership of smartphones. Between 2013 and 2014 UK smartphone penetration grew from 62 per cent to 70 per cent of the population – older age groups recorded the highest growth (Figure 3). Another factor contributing to this growth is improved connectivity.[10]

A report in October 2013, based on research by IMS Institute for Healthcare Informatics, examined over 43,000 mobile health apps that were available to download to Apple and Android devices from the Apple iTunes App store in June 2013. The research found that only 23,682 had a legitimate health function, 7,407 were aimed at HCPs and 16,275 were aimed at the consumer/patient. Of the health apps available on Android devices, more than 50 per cent achieved fewer than 500 downloads, while five apps accounted for 15 per cent of all downloads in the health category.[11]

Figure 3. UK Smartphone penetration by age group, 2013-2014



Source: Mobile consumer 2014: the UK cut, Deloitte, 2014

Growth in numbers and types of wearable devices

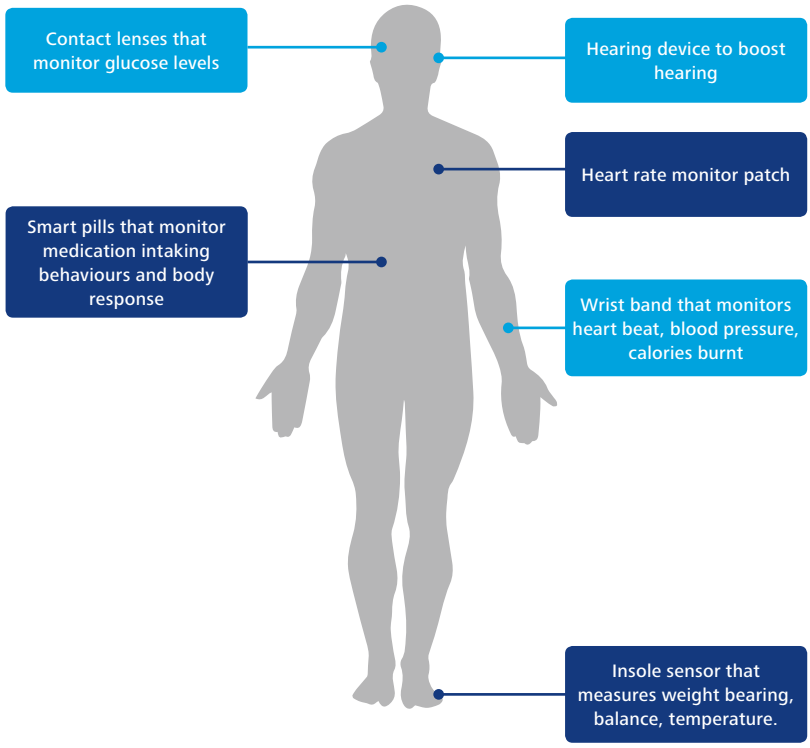
Another key development is the growth in wearable technology, and in particular, bio-sensing wearables. These devices include fitness bands, digital hearing aids, blood pressure monitors and ingestible devices such as smart pills (Figure 4). Recent innovations include clothing/textiles impregnated with sensors. Most wearable healthcare devices transmit data via an app. The global movement in TEC is the catalyst for the development of wearables.[12]

There are three main characteristics currently impacting the development of wearables:

- wearables work well only in conjunction with software (such as apps)
- there is a clear demand for monitoring devices that are unobtrusive and easy to use, and do not interfere with normal life
- there are a large number of small companies designing and developing wearable devices, and the market is highly fragmented.

Figure 4. The functionality and use of increasingly unobtrusive bio-sensing wearables

Wearables invade the market



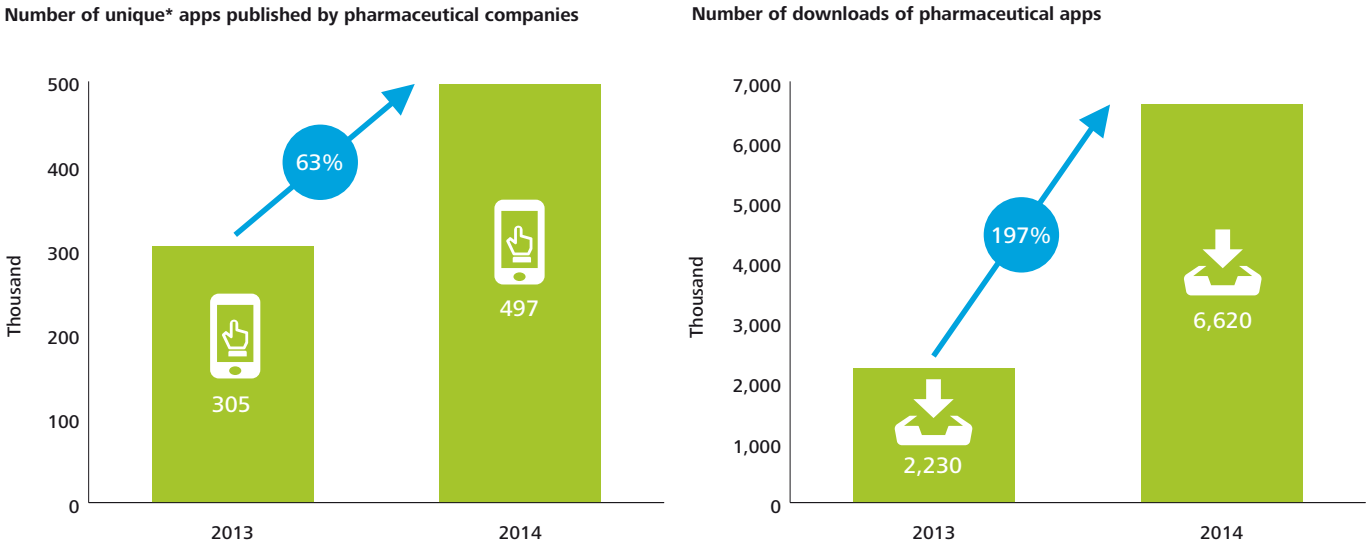
Source: Healthcare and Life Sciences Predictions 2020, Deloitte Centre for Health Solutions, 2014

Other market drivers

Demand for apps and wearables is also being driven by an increasing focus on personalised care and precision medicine. Pharmaceutical companies are using apps and wearable devices to collect patient data to support research and provide a more holistic service to patients. The leading pharmaceutical companies had 63 per cent more unique apps in the app stores in 2014 compared to 2013. Within a year, the total number of downloads of pharmaceutical apps increased by 197 per cent (Figure 5). These apps deliver education and training, can titrate medication and monitor compliance.[13]

There has been an increase in online patient communities, using social media as a platform to exchange experiences with patients and carers, connecting via apps or internet connections. For example the platform **www.patientslikeme.com** has a growing membership and collects large amounts of data (with patient consent) about drug side effects and patient interactions (case example 1).

Figure 5. Number of apps published by leading pharmaceutical companies, 2013 and 2014



* Unique apps: An app that is listed on both iOS and Android is counted as one unique app
Source: Pharma App Benchmarking, research2guidance, 2014

The leading pharmaceutical companies had 63 per cent more unique apps in the app stores in 2014 compared to 2013.

Innovation linked to healthcare in developing markets is an important contributor to the disruption of traditional healthcare

Developing markets provide huge opportunities for TEC developers:

- they comprise large rural, remote and disconnected communities with limited access to HCPs and low per capita spend on healthcare
- they have a high prevalence of communicable diseases and an increasing prevalence of non-communicable diseases
- it can be easier to be innovative where there is less entrenched or limited infrastructure and where TEC offers an opportunity to improve access.[15]

Some of the most innovative and disruptive healthcare developments are currently in developing countries, with important lessons for the more developed world who are increasingly looking to adopt the more frugal innovations. The increasing penetration of mobile phone ownership means developing markets which lack a health infrastructure have a lot to gain from TEC.

For example, Africa has 15 doctors per 100,000 inhabitants and 62 per cent of the population live in rural areas where access to medical facilities is extremely difficult. Tuberculosis, malaria and pregnancy-related problems account for three million deaths in Africa every year. Mobile phone penetration in Africa reached 82 per cent in 2014. This trend has encouraged the implementation of low cost digital health technologies used to reach underserved populations remotely or at the 'point of care' (case example 2).[16]

Case example 1

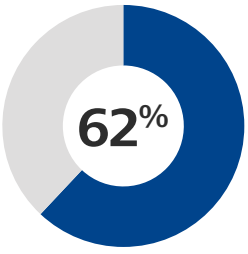
PatientsLikeMe – is a patient network and real-time research platform that advances medicine

PatientsLikeMe is an online patient community that is unique in both the depth of data it collects and the degree to which it shares with members. PatientsLikeMe users report data about the real-world nature of disease to help themselves and others; and to help researchers, pharmaceutical companies, regulators, providers, and non-profit organisations develop more effective products, services and care. While the majority of patients choose to share their data only with others in the community, many make their information publicly available to non-members or anyone simply searching for information. PatientsLikeMe also helps patients find clinical trials that are right for them and helps companies find patients who are right for their trial. Currently there are more than 300,000 members, covering 2,300 conditions and around 400 clinical trials.[14]

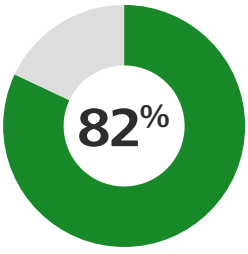
Case example 2

How mobile technology in Africa is helping overcome the lack of health infrastructure to support more agile and flexible working: serving populations and saving lives

- In Kenya mobile health technology has improved antiretroviral medication compliance by 11 per cent
- Botswana has successfully deployed a mobile-enabled programme that reduced government response time to malaria outbreaks from four months to three minutes
- Delivering prevention and awareness information via text message to pregnant young mothers in Mali has helped to reduce perinatal and maternal mortality by 30 per cent.[16]



62 per cent of the population of Africa live in rural areas where access to medical facilities is extremely difficult



Mobile phone penetration in Africa reached 82 per cent in 2014

Part 2. Tackling the barriers to the uptake of technology enabled care

There is wide variability across Europe in the maturity of the digital health market. Although there are pockets of excellence within the UK for the uptake of TEC, it nevertheless lags behind many other European countries in the extent of adoption. This part of the report focusses on the current barriers to wider adoption of TEC in the UK in the context of the European Commission's (EC's) 2014 consultation on developments across the Europe Union. It then considers the policy actions needed to improve mobile health deployment in the UK. Specifically it:

- summarises the EC's white paper report on mobile health deployment
- identifies additional points raised in the UK's combined government response to the EC's consultation
- considers how to improve staff engagement in use of TEC
- explores how to increase patient trust in apps and wearables
- reviews current policy initiatives in support of TEC.

Results from European Commission consultation on mobile health deployment in Europe

In April 2014, the EC in publishing its green paper on mobile health, launched a broad stakeholder consultation on barriers to mobile health deployment and the actions needed to unlock its potential.[17] The EC received 211 responses, including 26 from the UK. The key barriers identified were:

- the lack of agreed standards for data protection, privacy and security, of both the data and the devices
- concerns over patient safety, quality and liability
- concerns around a lack of evidence on cost-effectiveness and the time needed to develop this evidence
- the lack of a clear legal and regulatory framework
- poor interoperability and a need for common interoperability standards
- inadequate funding and reimbursement models
- inequality in patient and carer access to technology
- cultural resistance from HCPs.[18]

The actions suggested by stakeholders included:

- build trust by developing strong privacy and security arrangements (for example data encryption and authentication mechanisms) and clear governance structures for the use of big data, including being able to share data from health apps with electronic health records (EHRs)
- adopt key principles of data minimisation, data protection by design, and data protection by default, once the planned data protection regulation is adopted
- give patients control over their own data, specifically the kind of information he/she wants to share, while maintaining the right not to share, as well as enabling the patient to see who is using data and for what purposes
- develop binding rules on the delineation between lifestyle and wellbeing apps and clarify rules for when an app is a medical device and how these differences should be regulated
- gather evidence on the economic benefits and involve HCPs, patients and carers in co-designing solutions
- develop new business models, as most mobile technology services are not reimbursed in many EU countries nor is there a specific budget for it
- help entrepreneurs access the healthcare market.[19]

The EC plans to develop a set of policy responses based on the results of the public consultation during 2015.[20]

Although there are pockets of excellence within the UK for the uptake of TEC, it nevertheless lags behind other European countries in the extent of adoption.

The UK government's combined response to the EC consultation

The Department of Health (the Department) and the Devolved Administrations provided a combined UK response to the EC consultation.[21] Additional points raised in the UK response are that:

- frequently, mHealth solutions are considered from a technological perspective, when the current challenges are societal, including ensuring the level of patients' trust in health apps is the same as in HCPs
- mHealth solutions have an important public health dimension
- many 'solutions' are derived by technologists working independently from those wanting a solution. Research funders, and others aiming to enhance uptake of mHealth solutions, need to emphasise co-creation, rather than technology push
- the NHS plans to move to integrated apps, able to link with clinical systems, but notes that there are currently only a small number of examples of these types of apps (or Personal Health Records (PHR)) able to bring together information from clinical systems and patient provided information. The NHS cited two examples, Patients Know Best and Health Fabric (case example 3).[22]

The response also highlighted the fact that the Medicines and Healthcare Products Regulatory Agency (MHRA) has produced guidance addressing software issues, including clarifying how MHRA determines whether an app would be considered a medical device and related requirements.[25]

In a separate annex, NHS England noted that it was developing the infrastructure to support interoperability (the Integrated Digital Care Record initiative) to facilitate integration between apps and web-based innovations and core clinical systems. A key part of the underpinning architecture being the use of the NHS number as the primary identifier to link information across systems.[26]

Addressing staff reluctance to engage with technology

HCPs are often reluctant to engage with technology, partly due to the scale and pace of development and the speed and proliferation of development. There is also a lack of education and training in deploying them in a clinical setting and consequently, staff often lack the confidence to utilise the technology effectively.[27] There are also concerns about quality, reliability, data overload, privacy and security (Figure 6).

Case example 3

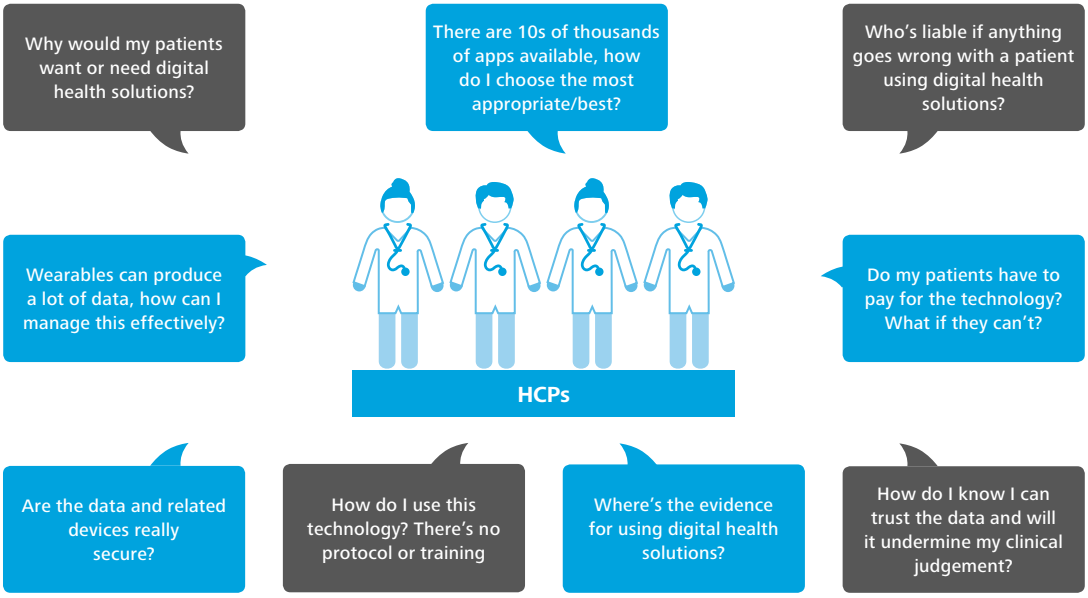
Apps identified by the Department of Health as bringing together patient and clinical information

Patients Know Best (PKB) – a patient owned healthcare record system. Patients monitor their own vital signs, and link to a PKB app or website via some 100 or so wearables and other devices. Information is retrieved, uploaded and shared with doctors and researchers if the patient agrees. When the results are outside the norm both clinicians and patients are alerted. PKB integrates fully into any health records system, including the NHS secure network, and is available for use by patients and clinicians worldwide.[23]

Health Fabric – an online, tablet-based, solution enabling patients to control their own health and social care record (via MyHealthFabric app), and integrate this with their GP systems so that personalised and integrated care planning can be executed with the patient owning their own information, accessed via tablet, mobile or web. This in turn helps multi-disciplinary teams to achieve the patient's personal outcome goals and allows more patients to live independently. It enables better quality contact and real time access to clinical and social care information at the point of care.[24]

Figure 6. Barriers preventing TEC adoption by HCPs

Staff, particularly doctors, are often reluctant to engage with technology, illustrating the importance of engaging staff during the design phase of deployment



Source: Deloitte Centre for Health Solutions analysis, 2015

One of the biggest concerns identified by doctors, is the limited evidence on outcomes, including cost savings. This may be because of findings published during 2013-2014 on the cost-effectiveness of the 2010 Whole System Demonstrator remote monitoring telehealth pilots. These showed that while there were reductions in emergency admissions, accident and emergency attendance (A&E) and length of stay, overall the intervention was judged as not cost-effective.[28] However digital technology nowadays is more effective, cheaper and can be deployed faster. Furthermore, apps can now be downloaded onto a smartphone reducing upfront costs and providing immediate access.[29]

Consulting staff during the design phase of app development and providing training on implementation is an important way of overcoming the above concerns.

Increasing patient trust in, and understanding of, health apps

There is increasing evidence that more informed patients are starting to improve self-care and adherence to medication, and boost health and wellbeing. There are also moves to raise the quality of apps, improve user confidence and trust, and introduce informed decision-making in app selection; for health professionals, patients and the public.

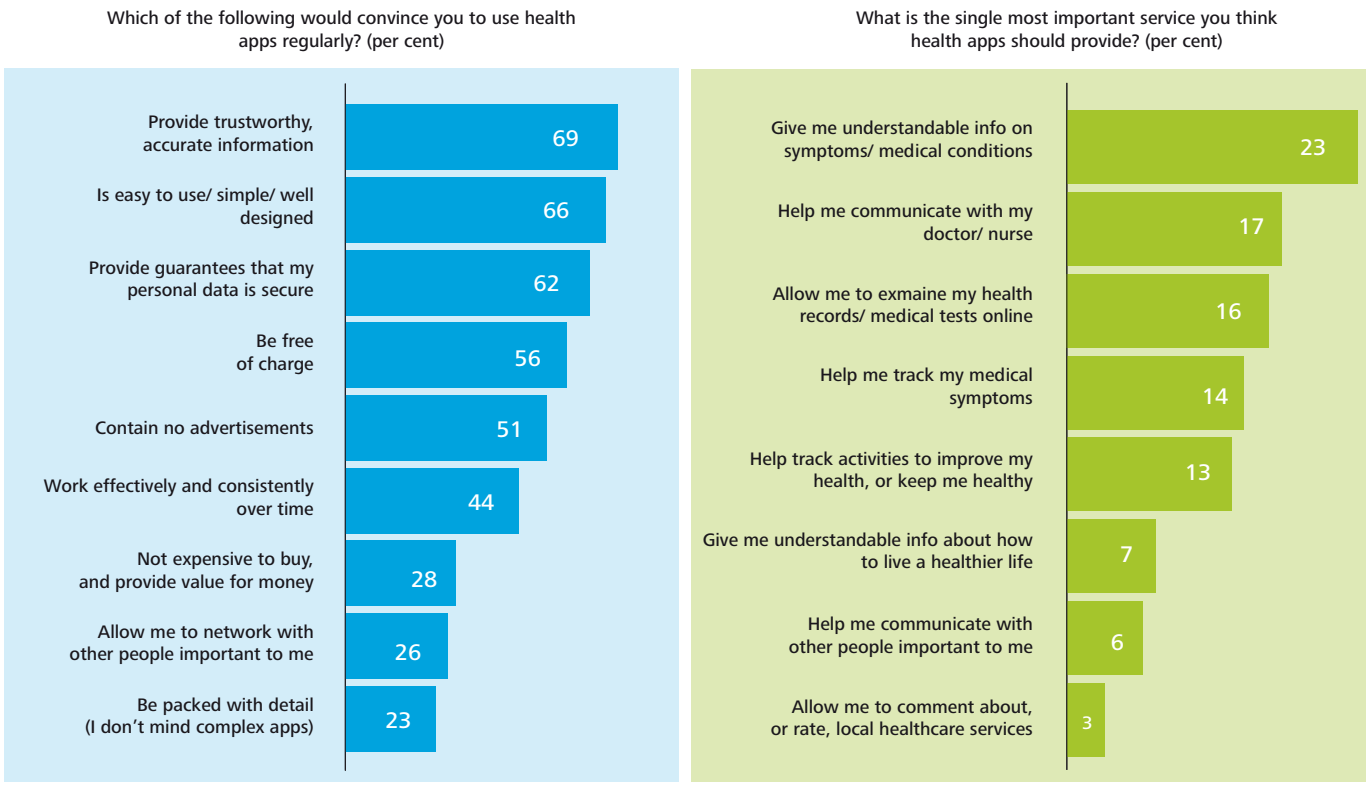
Agencies like the US Food and Drug Administration (FDA), or NHS Choices and its NHS Health Apps Library have developed criteria which judge apps for safety and technical proficiency. For example, for apps to be included on the NHS Choices search website, which in early 2015 lists around 150 apps, they must be reviewed by a technical team (testing relevance, legal compliance and data protection), then by a clinical team (to test scientific rigour).[30] This, however, is both resource intensive and time consuming, consequently the National Information Board is developing a national approach to the regulation of apps, devices and digital services.[31]

PatientView, an independent organisation that works closely with patients and health and social campaigning groups worldwide, has developed a systematic method of appraising health apps (myhealthapps.net). As at April 2015, there are 363 apps recommended for the Apple platform and 236 for Android, with smaller numbers recommended for use on other platforms.[32] In 2014, PatientView undertook a survey of 1,130 patient group members to identify what people want from health apps (Figure 7).

Tackling accessibility and equality of access

Technology has the power to improve access to healthcare services, particularly for those with mobility problems or who find travel difficult. Indeed, most people living in rural areas could benefit from faster access to remote consultations. On the other hand, patients may not be able to afford the technology and patients and providers may need financial support (government subsidies, grants or tax relief).[33]

Figure 7. What do patients and carers want from health apps?



Source: PatientView survey of 1,130 people with a long term condition, 2014[34]

Arguably the biggest challenge is not the development and implementation of new technologies, but ensuring equality of access. The UK government has stated that TEC services should be as accessible as traditional healthcare and reduce social inequalities rather than fuelling further divisions.[35] Connected health also relies on broadband connectivity with current variations in broadband speeds creating a broadband divide, increasing inequalities in access.[36]

Current UK Government initiatives in support of TEC

NHS England support for TEC is key to improving its adoption

The NHS Five Year Forward View (5YFV) for England, published in October 2014, provides a five-year plan for evolving the NHS, including developing new models of care and more investment in workforce, technology and innovation.[37] The 'Forward View into action: Planning for 2015-16', includes developing a number of "test-bed" sites focussed on deploying and evaluating the impact of different technologies and innovations. These test-beds involve life science and health technology industries partnering with the NHS to demonstrate how digital innovations can deliver improvements in outcomes, patient experience and cost-effectiveness.[38]

NHS England has also established a National Information Board (NIB) to take forward the government's updated digital health strategy, emphasising how technology can impact staff and patients.[39] In addition, the TEC Services programme, born out of the predecessor 3millionlives programme, has been refocused to create a commissioning environment to support adoption of technology and deliver more cost-effective services by 2020.[40] The National Information Board has agreed nine work streams in relation to its 'Personalised Health and Care 2020: A Framework for Action' and in March agreed strategic priorities for data and technology in health and care alongside defined timelines.[41]

Some of the key actions include:

2015

From April 2015

- Patients will have access to their GP summary care record
- Use of the NHS number as primary identifier will be mandated across health and care

By June 2015

- Proposals on the regulation, accreditation and kite marking of technology and data-enabled services will be published

2016

2017

By April 2017

- Core education curriculum and associated knowledge frameworks will contain the knowledge and skills to enable the workforce to embrace IT

2018

From March 2018

- Patients will have access to all their health records (held by GPs, hospitals and community, mental health and social care services)

2019

2020

By 2020

- All care records should be digital real-time and interoperable and the health system will have adopted SNOMED clinical terminology.[42]

Initiatives to support adoption of TEC in Northern Ireland, Scotland and Wales

Healthcare systems in Scotland and Northern Ireland, which have traditionally had a much more integrated approach to health and social care, are at the forefront of exploiting the opportunities for TEC. Indeed, the UK's three devolved governments all have eHealth strategies and TEC initiatives.

In Scotland, TEC is central to integrated service delivery and, in March 2015, the Scottish Government announced a further £30 million of funding over three years to increase the number of people receiving support, diagnosis and treatment at home.[43] The TEC Programme builds on the success of previous programmes of national support such as the Telecare Development Programme which ran from 2006 – 2011, and increased access to telecare services for almost 44,000 people in Scotland. Evaluation showed around 2,500 hospital discharges were expedited as a result of the programme, while at the same time around 8,700 unplanned hospital admissions and over 3,800 care home admissions were also avoided.[44] The TEC Programme is aimed at increasing choice and control in health, care and wellbeing for an additional 300,000 people. The Scottish Government has also established the Digital Health Institute to foster and encourage the growth of digital healthcare in Scotland.[45] In March 2015, it published a refreshed eHealth Strategy emphasising the expectations and requirements of citizens and patients for electronic information and digital services.[46] Meanwhile, the Scottish Centre for Telehealth and Telecare, within NHS 24, is working with a broad range of stakeholders to develop technology enabled models for redesigning health and care services 'at scale' (i.e. for tens of thousands of Scotland's citizens) such as, Living it Up, SmartCare and United4Health.[47]

The Telemonitoring NI service in Northern Ireland, established in December 2011, provides TEC services, delivered by the TF3 Consortium (comprising Tunstall, Fold and S3 Group, working in partnership with the Centre for Connected Health and Social Care). Over three years into a six year programme, nearly 3,000 patients have benefited from the Telemonitoring NI service to date. It monitors vital signs including pulse, blood pressure and blood glucose levels at home on a daily basis, alerting local HCPs if readings deteriorate to an unacceptable level. It also provides telecare services across Northern Ireland, providing continuous remote monitoring by means of sensors and alarms to enable people to live in their own home while minimising risks associated with falls and other emergencies.[48]

Over the last three years the NHS Wales Informatics Service has developed an online appointment booking system and shared patient records for out-of-hours primary care. In 2014-15, £9.5 million from the Health Technology Fund was allocated to four key areas: connecting primary care (£2.33 million); hub and spoke models (£0.53 million); telemedicine (£2.87 million); and enabling infrastructure (£3.92 million). In March 2015, the Welsh Government announced the development of a refreshed strategy in eHealth and Care which will be published in Spring/Summer 2015.[49]

Connected health also relies on broadband connectivity with current variations in broadband speeds increasing inequalities in access.

Part 3. Connected patients: shifting the balance of power

Mobile technologies can empower patients and carers by giving them more control over their health and social care needs and reducing their dependence on HCPs for information about their health. This part of the report considers how TEC can:

- improve self-management through education, remote monitoring and treatment adherence
- tackle areas of high unmet need that traditional approaches have struggled to address, such as mental health
- support development of online patient portals and patient communities
- shift the balance of power and transform the relationship between the patient and carer to one focussed on co-creation.

Using TEC as an enabler for self-management

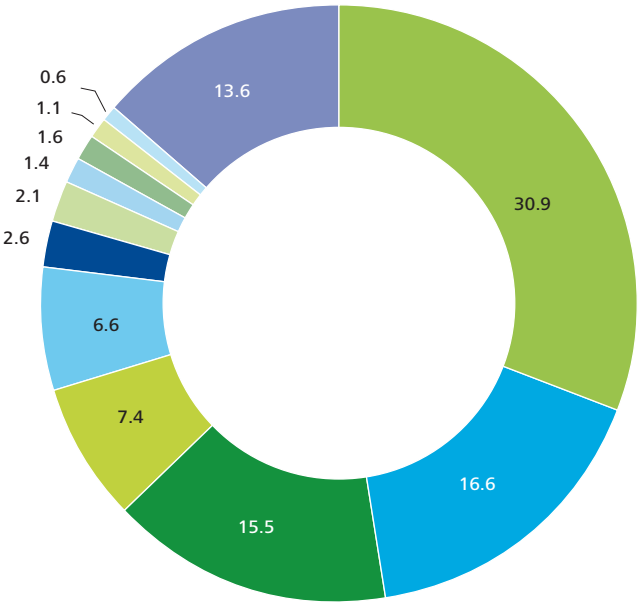
Patients and carers increasingly use mobile technology to research information online, share experiences, identify treatment options, rate providers and help diagnose illnesses. Healthcare commissioners and providers have acknowledged that current and emerging technologies offer opportunities to transform the way people engage with their own health.

Digital technology connects patients and providers, leading to better health outcomes and a more convenient and personalised service, through: informing/educating; two-way remote monitoring; and supporting treatment adherence.[50]

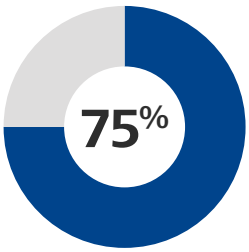
Informing and educating patients and carers

Some 75 per cent of the UK population now goes online for health information. Education technologies such as websites, apps, videos, texts and Open Online Courses (OOCs) are used to deliver education and information to patients and their carers. The most common category of mobile apps are fitness, medical reference and wellness apps, which largely provide information and have limited other functionality (Figure 8).[51]

Figure 8. Digital health app category, percentage share in 2014



Fitness
Medical reference
Wellness
Nutrition
Medical condition management
Electronic health records
Continuing medical education
Diagnosis
Compliance
Reminders and alerts
Remote consultation and monitoring
Others



Some 75 per cent of the UK population has searched online for health information

Source: Research2guidance, 808 apps from Apple App Store, Google Play, Blackberry App World and Windows Phone Store, 2014

There remains a need to bridge the gap between app functionality and clinical guidelines. For example, research on the diabetes app market found that the four most prevalent features of apps available online were insulin and medication recording (62 per cent), data export and communication (60 per cent), diet recording (47 per cent), and weight management (43 per cent). Clinical guidelines identify education as critically important, yet this functionality is missing from many diabetes apps.[52]

The use of digital technology to educate and instruct is an important driver of patient engagement. Surveys have suggested that patients are more likely to be engaged in their health and make better choices about their care if they have easy access to information. Online access is also an important enabler of self-management for patients with chronic conditions.

In addition to benefits for the patient, digital technology can provide invaluable support to carers. Informal carers make a crucial contribution to delivering health and social care, with around 6.5 million carers in the UK (more than twice the combined health and social care workforce) estimated to save the state some £119 billion a year.[53] TEC can help carers understand and support those they care for by:

- providing psychological reassurance
- enabling carers to co-ordinate their work-life-care balance through supporting flexible hours and remote working patterns (some 2.3 million people have had to give up work to become carers and three million have reduced their hours)
- delivering peer-to-peer support.[54]

The use of digital technology to educate and instruct is an important driver of patient engagement.

Remote monitoring

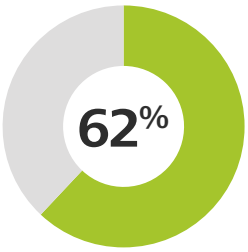
Remote monitoring (also known as home-telehealth) uses technology to monitor changes in patients' health status outside of conventional clinical settings. Historically based on conveying information through fixed-line technology, it allows a patient to use a device to perform a routine test and send the test data to a HCP. Initially, it depended on HCPs recommending its use to patients. However, digital technology has increased the potential for remote monitoring and, with the advent of apps and wearables, patients are increasingly bringing the innovation to doctors.[55]

Recent advances in the development of bio-sensing wearables are extending their capability to move beyond simply tracking activity. New entrants are able to monitor continuously a broad range of physiology (from posture to brain activity) and convert this information into outputs, through advanced connectivity and computing power.

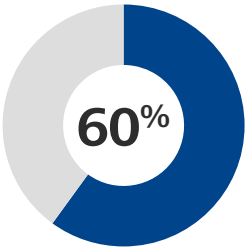
Bio-sensing wearables support people with chronic conditions, automating monitoring and detecting real time changes in an individual's health status (see Part 1). Data from bio-sensing wearables can be uploaded online to an Electronic Patient Record (EPR), ideally a Patient Health Record. These data can be used to provide a complete medical history and real-time information to support early diagnoses and prevent crises. If a negative change occurs, patients and carers can be alerted quickly – helping prevent deterioration, and reducing A&E attendances and emergency admissions. The use of bio-sensing wearables is particularly important in supporting older people to "age in place".

Chronic Obstructive Pulmonary Disease (COPD) is one of the most prevalent long term conditions. Of the three million people living with COPD, fewer than a third receive adequate treatment. Remote monitoring is particularly effective in supporting people with COPD to improve control of their condition (case example 4).

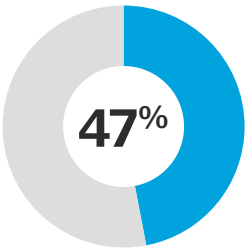
Research on the diabetes app market found that the four most prevalent features of apps available online were:



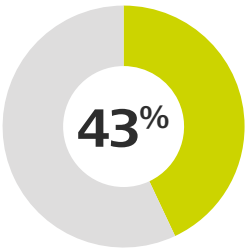
Insulin and medication recording



Data export and communication



Diet recording



Weight management

Case example 4

Using medical health apps to support people to improve the management of Chronic Obstructive Pulmonary Disease (COPD)

Situation	Action/methodology	Outcome/Impact
Harrow CCG commissioned Merck Sharp and Dohme (MSD) 'healthcare services division' to improve care of COPD patients	Trial of a patient monitoring service called 'Closercare' which provides patients with remote monitoring devices wirelessly linked to a team of nurses. Abnormal results are picked up by the nurses who ring the patient and either monitor them more closely or contact local community HCP teams	The trial was independently evaluated by the University of Hull. By using the service over three months patients experienced a: • 50 per cent drop in admissions • 12 per cent drop in A&E attendances • 63 per cent drop in hospital bed days • 16-20 per cent cost saving for patients with a previous hospital admission.[56]
East and North Hertfordshire CCG and Medtronics project: helping people to age well and find a way for technology to support people with COPD	Use of Medtronic devices to monitor remotely the vital signs of COPD patients; clinical input used to set biometric thresholds; agreed escalation route for patients through 111 and trained Herts Urgent Care nurses	• 24 per cent reduction in GP appointments • 97 per cent patient satisfaction • 62 per cent of patients more confident • 94 per cent compliance with treatment regimen.[57]
Bristol CCG and SafeMobile care. Scaling up the use of technology in management of COPD	Values related to blood pressure and weight are recorded and communicated via an app, user can also record his or her wellbeing (e.g. breathlessness)	All patients reported feeling empowered to manage their condition. There was: • 40 per cent less nurse phone contact • 18 per cent fewer nurse visits • 26 per cent reduction in overall contact • 83 per cent reduction in calls to GP • 57 per cent reduction in visits to GP, alongside significant reduction of unplanned COPD admissions.[58]

Enhancing treatment adherence

Failure to adhere to treatment regimens can result in deterioration in the patient's condition leading to increased likelihood of hospital admission and, in the worst case, death or permanent disability. Electronic reminders and alerts, via text SMS or apps, can support patients to adhere to therapies and treatment regimens, improving health outcomes.

The World Health Organisation has calculated that adherence to long-term therapies in developed countries is around 50 per cent, and even lower in developing countries.[59] In the UK between one-third and half of all medicines prescribed for long-term conditions are not taken as recommended. The Department estimates that the cost of unused or unwanted medicines is around £100 million annually.[60]

Improved adherence allows HCPs and pharmaceutical companies to obtain a better understanding of the impact of drugs, including any complications or drug interactions, providing useful data for research. An increasing number of pharmaceutical companies are investing in digital TEC projects to increase patient adherence to the drugs they produce. Likewise, patients and carers are increasingly using digital health software to register and monitor medication intake.[61]

TEC is helping to transform care for people with mental health conditions

Mental ill health is the single largest cause of disability in the UK, contributing up to 22.8 per cent of the total burden, compared to 15.9 per cent for cancer and 16.2 per cent for cardiovascular disease. The wider economic costs of mental illness in England have been estimated at £105 billion per year (direct costs of services, lost productivity at work and reduced quality of life). These costs are forecast to double in real terms over the next 20 years. A growing body of evidence suggests the costs could be reduced by greater focus on mental health promotion and prevention, alongside early diagnosis and intervention.[62]

A report published by the charity Mind shows that many people wait too long to receive treatment and struggle to access services and that technology can help people with mental health issues. Patient forums and information sharing portals can help tackle isolation and provide an opportunity to talk (openly or anonymously), while supporting self-management of their condition.[63]

The government strategy, 'No health without mental health' considers how digital technology can support new ways of working with people at risk of, or suffering from, mental health problems. For example, connecting people with similar issues, offering services such as computerised cognitive behavioural therapy and keeping people in touch with HCPs, for example, texting reminders of appointments. Technology can also be a less stigmatising way of accessing support.

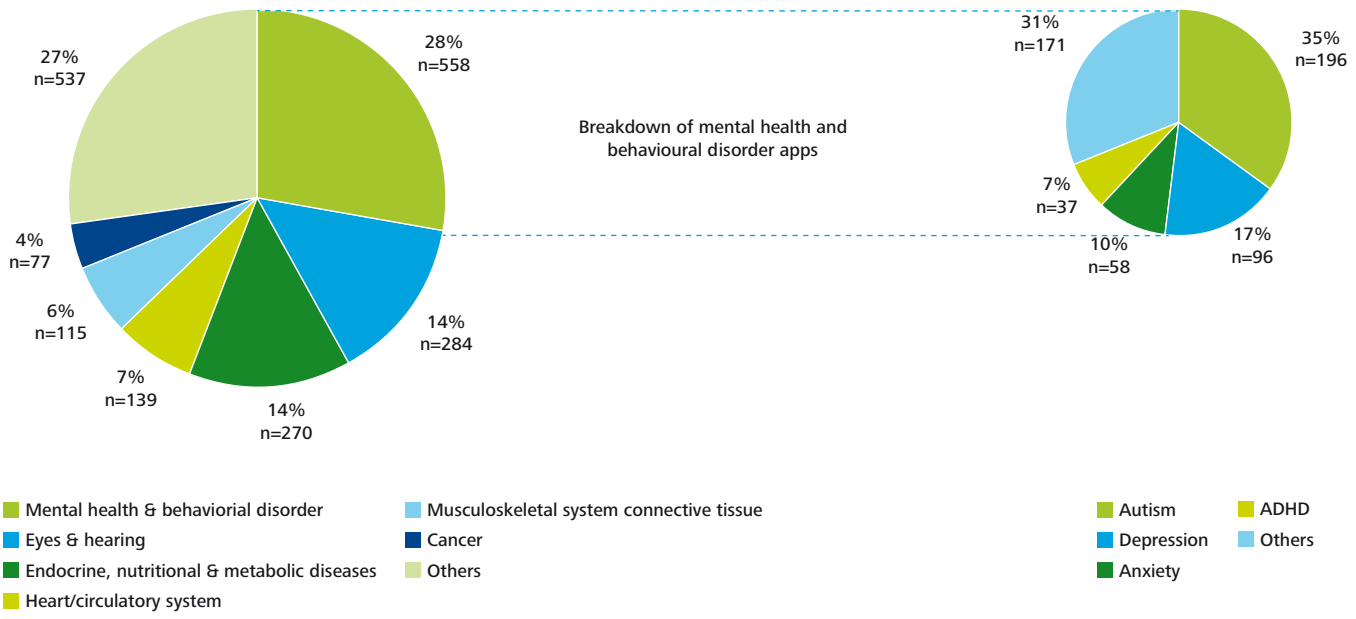
The number of mental health apps has increased rapidly in the past few years. In 2013 a review of some 43,698 health apps available from the Apple iTunes App store found 1,980 to be related to specific therapy areas. Of these, 558 or 28 per cent were found to be in the mental health category (Figure 9).[64] There is also a growing evidence base demonstrating improved patient outcomes (case example 5).

Case example 5

Examples of mental health apps delivering improved patient outcomes

- **Big White Wall** Some 80 per cent of users of www.bigwhitewall.com (an online platform that offers users an opportunity to record their mood, chat with other users and get in touch with HCPs via video, text and audio) report that they have found ways to manage their daily lives more effectively. 95 per cent feel better after using it. Estimated savings are some £340 per user per year.[65]
- **Beating the Blues** Aims to improve the lives of patients suffering from anxiety and depression through an app with a computerised Cognitive Behaviour Therapy (CBT) programme. Patients reported significantly higher treatment satisfaction than those receiving a comparative eight weeks of usual care. Symptom reduction was paralleled by improvement in work and social adjustment.[66]

Figure 9. Breakdown of apps by therapy area, 2013



Source: Patient Apps for Improved Healthcare: From Novelty to Mainstream, IMS Institute for Healthcare Informatics, 2013

Developing online patient portals

In addition to online patient portals like PatientsLikeMe, healthcare providers are also developing their own online patient portals that give patients access to their health information, either directly or via apps; improving communication between patients and providers. The US has some of the most established examples of online patient portals including Kaiser Permanente Northern California (case example 6), the Department of Veteran Affairs and Geisinger Health System which all report improvements in care while reducing costs using patient portals.[67]

The NHS is currently establishing a portal for people at the end of life, building on the success of Co-ordinate My Care in London (case example 7). Meanwhile, digitisation of the Personal Child Health Record, the Red Book, will provide new mothers with a patient portal that supports personalised mobile care records for their child on their smart phone or tablet by 2016.[70]

Connecting patients and shifting the balance of power

Connecting patients to information, advice and support, as described in the above examples, can help move from the patient as a passive recipient of care to one where they are actively engaged in their own care. (Figure 10).

Case example 6

Kaiser Permanente Northern California and its online patient portal

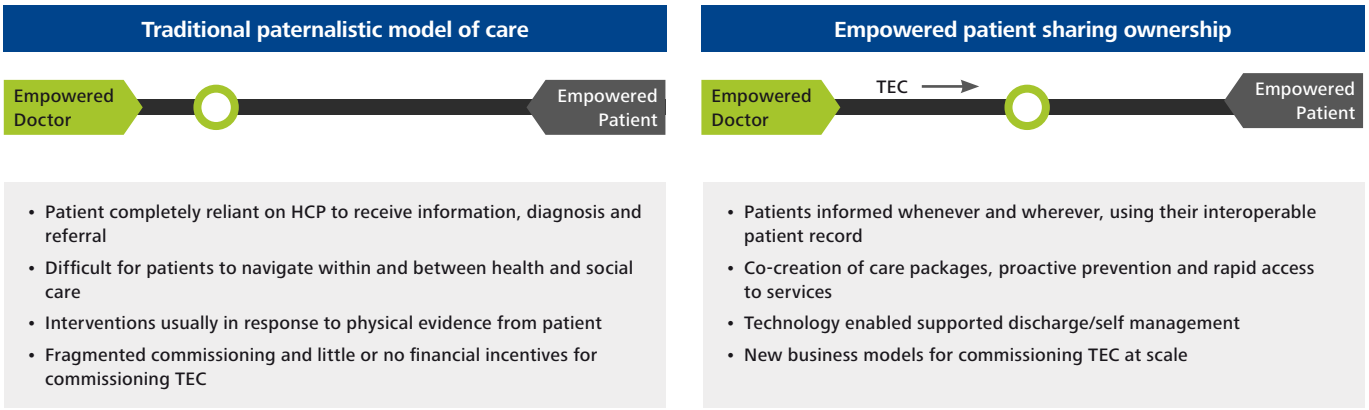
Since 2008, Kaiser Permanente Northern California (KPNC) has operated an inpatient and ambulatory care EHR system for its 3.4 million members. The number of virtual visits has grown from 4.1 million in 2008 to 10.5 million in 2013. It also provides a suite of mobile and tablet applications enabling members to exchange messages with their doctors, create appointments, refill prescriptions, and view their lab results and medical records. The smartphone app supports self-service transactions while the tablet app focuses on prevention and health analytics, to achieve KPNC's 'total health' vision. In 2013, some 2.3 million telephone consultations were made via mobile phone compared to around 64,000 in 2008.[68]

Case example 7

Co-ordinate My Care (CMC)

Despite a third of the total healthcare budget being spent in the last year of life, many patients and their families do not receive the care they want because the agencies involved are not aware of their wishes. CMC, developed at the Royal Marsden NHS Foundation Trust, lets patients with life-limiting illnesses develop a personalised urgent care plan that is shared electronically with all agencies and professionals involved in their care, including NHS 111, the London Ambulance Service, GPs, social care and A&E. With over 10,600 registered users and 7,000 trained clinicians, the service is having a significant impact on palliative care in London. More than three-quarters of the people who have died while on the programme did so in the place of their choosing, improving patients' experience of end-of-life care and creating savings for the NHS. An independent evaluation calculated that the reductions in hospital attendance and length of stay, achieved through giving professionals access to patients' wishes, delivered an average saving of £2,100 per person.[69]

Figure 10. Connected patients: shifting the balance of power



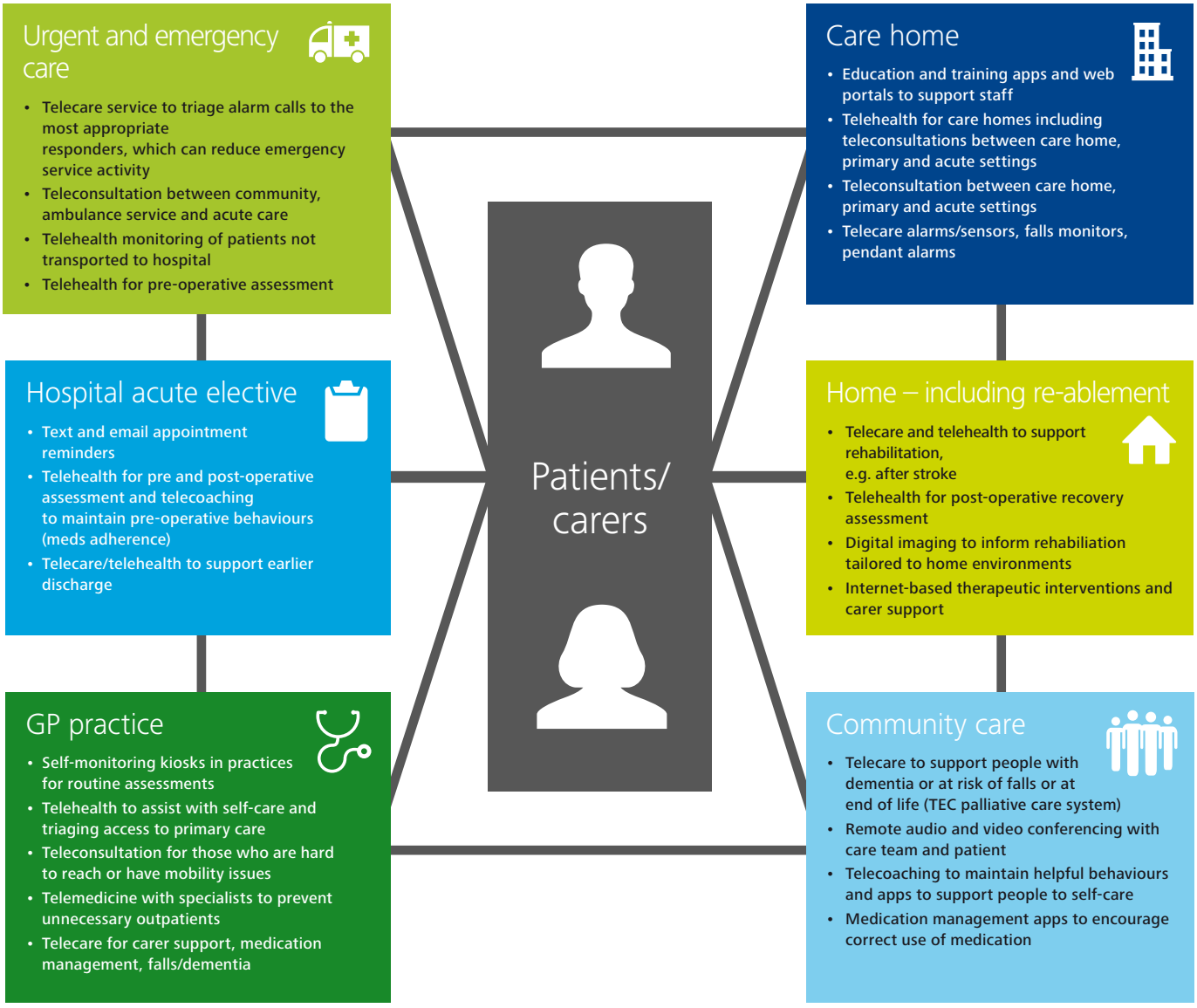
Source: Deloitte Research, 2015

Part 4. Connected providers: transforming ways of working

The exponential rise in TEC requires healthcare providers to redefine staff roles and responsibilities and support them to work differently. Currently healthcare is largely defined by 'place' of work and based on providing hands-on care to patients. As TEC services are adopted more widely, staff can undertake e-visits, write e-prescriptions and track, diagnose and deliver treatment via remote digital monitoring; delivering benefits for providers, with savings in direct costs and staff time.

Staff can also connect across organisational silos (Figure 11). This part of the report considers how different providers are responding to the barriers highlighted in Part 2 and the extent to which they are starting to work differently. It also considers how digital technology is facilitating new entrants to the provider market.

Figure 11. Examples of how mobile technology could be used to connect staff with patients and support staff to work differently, including connecting across organisational silos



Source: Deloitte Research, 2015

Case example 8

The Hurley Group of GP practices using webGP to improve practice efficiency and patient outcomes

The Hurley Group comprises 17 GP practices across ten London boroughs, with 100,000 registered patients and treats 350,000 minor illnesses and injuries a year at eight clinics. By 2014, the practice team had grown to 400 staff (compared to 25 in 2006) while maintaining the traditional NHS GP partnership structure. In 2014 it began piloting technology services – building a platform to source frontline peer and specialist advice. Virtual surgeries conduct online consultations with patients, aimed at improving the patient experience and outcomes, and enhancing practice efficiency. The practice website offers symptom checkers, self-help content, sign posts to alternate resources and enables patients to email their own GP and select own GP secure e-consult or 24/7 call back.

A review of 133,000 patient contacts shows better access, improved health outcomes, practice efficiency and commissioner savings, and less patient overflow in urgent care settings. As well as empowering patients with access to their medical records, scalable technology solutions are delivered to the frontline of primary care. These have resulted in:

- 36,000 website hits in six months
- 83 per cent of patients saying they would recommend
- 95 per cent of interactions rated as very good or excellent
- 20 per cent of interactions accessed using mobile phones.

A third of patients go on to self-manage. Other outcomes include digital disinhibition (for example in case of mental health concerns), care starts sooner, fewer GP appointments needed, shorter waiting times and more time for complex cases.[73]

Improving efficiency in general practice

GP practices have led the way in the move from paper to digital record-keeping. However they remain slow in adopting technology in their interface with patients. Many GP practice's already offer telephone appointments, telephone triage, email consultations and use text messaging to notify patients of appointments. However their adoption of telecare and telehealth has been patchy; and the potential for such technology to support primary care in making home care more effective, personalised and convenient, is under-developed.[71]

The potential benefits of adopting TEC includes reductions in the number of unnecessary visits to the GP and fewer unnecessary face-to-face appointments, leading to lower costs and more face-to-face appointments for serious complaints.[72] In London, the Hurley Group is demonstrating benefits from using technology to engage with patients (case example 8).

To address the funding constraints associated with implementation of TECs in primary care, NHS England has made a number of funding sources available to GP practices:

- October 2013 – Prime Minister's £50 million Challenge Fund to help improve access to general practice and stimulate innovative ways of providing primary care services[74]
- September 2014 – the Prime Minister announced a new second wave of primary care access pilots, with further funding of £100 million for 2015-16[75]
- January 2015 – a new £1 billion NHS primary care infrastructure fund, which includes as eligibility criteria that practices must offer patients more time with doctors, expand the services on offer, keep patients healthier at home for longer and reduce emergency attendance or admission to hospital of over-75s. Practices are expected to invest in technology to meet these criteria.[76]

Improving healthcare in residential and nursing homes

Around 325,000 older people live in care homes in England. Care home residents have 40 to 50 per cent more emergency admissions and A&E attendances than the general population of over 75 year olds and significantly less elective and outpatient appointments. Forty-two per cent of those admitted from care homes are in the last six months of life.

The number of conditions on admission is three times higher than in comparator populations with a greater number of multiple admissions.[77] Case examples 9 and 10 show how TEC services can improve care in care homes.

Case example 9

Using TEC to connect care homes to hospital services to deliver better outcomes and more cost-effective care

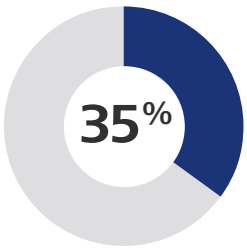
A partnership between Airedale NHS Foundation Trust and technical providers offers telemedicine to some 210 nursing and residential care homes around the country, with services for a further 113 homes in train. The aim is to improve the healthcare provided to residents and reduce unnecessary hospital visits. Access is available 24/7, via a two-way secure video link between patients and a clinician based at a Telehealth Hub centred at Airedale Hospital. An audit comparing nursing and residential care homes in Airedale before and after the implementation of telemedicine, showed a 35 per cent reduction in hospital admissions (based on hospital episode statistics for around 2,000 residents in 23 local care homes). It also found the use of A&E fell by 53 per cent and the number of hospital bed days were down 59 per cent.[78]

Case example 10

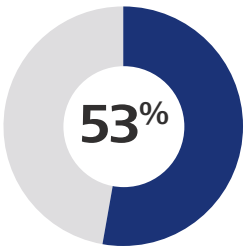
Low intensity telehealth in nursing homes in Sussex

As part of an eight-month "low intensity telehealth" trial during 2013-14, 92 nursing and care home residents were given Android tablet computers fitted with a customised app that enabled staff to ask the patients questions about how they were feeling. The information was analysed remotely by four "admission avoidance matrons"; anything untoward about a patient's readings triggered an alert. During the trial, the matrons received 252 alerts as a result of heart failure, 181 for breathing problems, 36 for urinary tract infections and 20 for diabetes. This early warning system, which cost 90p a day per patient, has led to a 75 per cent drop in hospital admissions. Staff were able to intervene earlier, for example, changing a patient's drug regimen.[79]

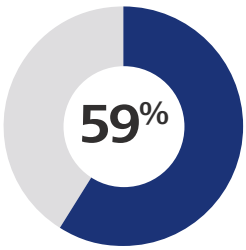
Outcomes of implementation of telemedicine in care homes:



35 per cent reduction in hospital admissions



use of A&E fell by 53 per cent



number of hospital bed days were down by 59 per cent

Case example 11

Supporting care at home – NHS Ayrshire and Arran improving patient pathway for Chronic Obstructive Pulmonary Disease (COPD)

All patients with COPD receive a HomePod (touch screen tablet), paired to a medical device (such as blood pressure monitor, pulse oximeter and weighing scales). This initiative was developed to improve the wellbeing of patients with COPD, reduce unplanned hospital admissions, and reduce pressure on GP appointments and out-of-hours service. Data is transmitted in real-time to a clinician who reviews and responds as required. The service began in 2011 and is now used by 150 patients. A cost effectiveness analysis concluded:

- Savings of 40 per cent compared to "usual care" (equating to £100,000 a year)
- 26 per cent reduction in GP appointments
- 70 per cent reduction in emergency admissions to hospital
- 86 per cent reduction to local out of hours service (Ayrshire Doctors on Call).

Feedback from patients shows satisfaction with the technology, an increased sense of security at being monitored and reduced stress due to reductions in GP or hospital check-ups. Feedback from the care teams indicates that patients are much more aware of their condition and able to manage it better. Medication adherence has also improved as the impact of their treatment on their condition is evidenced. It has also enabled closer working relationship between NHS Ayrshire and Arran, and Local Authority staff in the joint management of COPD.[80]

Supporting care at home

Mobile technology has huge potential to help NHS organisations deliver more effective home care and support re-ablement. For example, 24/7 remote monitoring can facilitate earlier discharge and reduce hospitals admissions (case example 11).

Improving efficiency of care in the community

Community services provide health, well-being and care services from childhood to the end-of-life, with some 100 million community contacts each year, ranging from health visiting and school nursing to targeted specialist interventions in musculoskeletal services, chronic disease management and intensive rehabilitation. Community services can help move more services out of hospitals, closer to home, and shift the focus from reactive care to prevention and proactive, early intervention.[81] Evidence on the impact of community services has historically been quite poor, however, evaluations undertaken as part of the NHS Transforming Community Services programme is starting to change this (case example 12).

Designing community services in a way that connects them to the rest of the health and social care system requires a fully integrated mobile solution and a technology platform that provides the HCP with a consistent user interface to the information they need. Indeed, community healthcare workers require a user interface that allows online and offline working. It needs to facilitate scheduling of visits, access to patient information and two-way capture and synchronisation of administrative and clinical information. It is also important that devices are encrypted in a way that protects patient data appropriately. Case example 13 shows how one community provider is exploiting mobile technology.

Case example 12

The results of the Mobile Health Worker project, part of the Transforming Community Services programme

Information was collected over a 15 month period (2010-2011) for the Mobile Health Worker project. It concluded that while the solutions are not 'one size fits all', and financial savings will vary greatly across different services and different organisations, the adoption and long-term use of appropriate mobile solutions has the potential to significantly improve productivity, efficiency, safety and assist services to continue to provide good quality care and achieve good outcomes, including up to:

- 142 per cent increase in productivity
- 104 per cent increase in time spent with patients
- 33 per cent reduction in journey times
- 11 per cent increase in clinical activity
- 92 per cent reduction in data duplication
- 34 per cent reduction in referrals
- 91 per cent reduction in admissions
- 50 per cent reduction in number of access visits.[82]

Case example 13

TotalMobile and Virgin Care – transforming community services

Virgin Care, responsible for running NHS community services in Surrey, has equipped staff with tablet computers running TotalMobile™, a mobile working solution that gives nurses access to essential information needed while visiting patients at home. Early evaluation of the deployment has found that each nurse is able to see around two extra patients a day. There has been a 60 per cent reduction in time spent on paperwork, freeing up time for patients (patient-facing time increased by 29 per cent in the first 12 weeks).[83]

Case example 14

Using Integrated Digital Care Fund to transform patient care in hospital

Northampton General Hospital recognised a need for improvements in patient observations. As in many other trusts, nurses were handwriting notes in charts placed at the end of patient beds. This was time consuming and open to wide margins of error. The solution, VitalPAC is an electronic patient observations system which can automatically summon help if a patient's health deteriorates. It uses PDAs or tablets across the hospital, is used by 1,500 staff across 28 wards and is the first of its kind in the region. It has delivered efficiencies in patient tracking and reduced errors by 300 per cent.[86]

Case example 15

US healthcare systems using telemedicine to improve access and efficiency across whole health economies

Avera Health – the South Dakota-based health system operates seven hospitals and provides a telemedicine service (eCare) to a network of 86 hospitals and over 100 facilities across 600,000 square miles (the size of France and Germany combined). Its telemedicine services comprise eICU, eEmergency, ePharmacy, eConsults and eLTC (for long-term care). Avera estimates it has seen more than 210,000 patients via eCare, saving an estimated $143 million a year in healthcare costs.

Geisinger Health System – the Pennsylvania-based system was an early adopter of telehealth and in 2012, showed that technology cut readmission rates by 44 per cent. It has focused strongly on eICUs, with HCPs working remotely to supplement ICU coverage when and where it's needed most. It has also found that telemonitoring for heart failure patients, saves $216, or 11 percent, per patient per month.

Mercy Health – has 33 hospitals in four states and in 2014 its TeleICU solution monitors more than 450 beds in 25 ICUs across the region. Reported benefits include: a 15-20 per cent reduction in ICU mortality rates, a 10-15 per cent reduction in ICU length of stay, reduced code blues, significant reduction in ICU nurse turnover and improved patient satisfaction.[87]

TEC is transforming hospital care

Digital capability in NHS hospitals is variable, with most hospitals having a large number of separate and unconnected systems. Handheld or palm-based computing technology such as personal digital assistants (PDAs), are beginning to have a measurable impact on healthcare, leading to an evolution in the way clinical data and information moves to and from the bedside to the patient record.[84]

The Safer Hospitals, Safer Ward Technology Fund launched in 2013, aims to drive improvements in patient care, ease pressure on A&E departments and replace outdated paper based systems for patient notes and prescriptions. In May 2014, the initiative became the Digital Technology Fund. Investments totalled £200m in 2013 -14 and 2014-15 respectively (case example 14).[85]

Meanwhile, the US is leading the way in using digital technology and telemedicine to transform ways of working across hospitals and community care. Case example 15 highlights a selection of US organisations that have adopted the technology at scale.

Telemedicine can transform care across a whole health economy

Accountable care organisations, or vertically integrated organisations are incentivised to deliver care closer to home and reduce more expensive hospital admissions. This has been widely recognised in the 5YFV and is one of the alternative models being promoted under the Vanguard application process.

In March 2015, 29 vanguard sites were chosen to implement new models of care in which digital technology will be a key enabler.[88] However, currently few examples of technology enabled telemedicine and integrated care exist in the UK. Case example 16 shows an enterprise wide approach being used in the US using mobile technology to facilitate improvements within the hospital and in the move from hospital to home.

Case example 16

Phillips Hospital to Home – an Enterprise approach to care delivery: deploying digital telehealth across hospital and community care

Phillips Hospital to Home aims to transform care through workflow re-design, complex analytics and advanced telehealth technologies. It can help increase provider productivity, deliver cost savings, and improve clinical outcomes. In helping the transition to outpatient and home settings it uses discharge management and tailored care coordination, employing eTelehealth devices, audio/visual technology and behavioral-based patient engagement tools to support greater self-care, deliver improved access and generate better patient outcomes. For example:

eICU can monitor multiple ICUs at one time, helping hospitals tackle the shortage of intensivists, identify staff gaps and enable HCPs to focus more on patients. A five year study of the eICU Program (118,990 critical care patients, across 56 ICUs, 32 hospitals and 19 health systems) demonstrated statistically significant reductions in mortality and length of stay:

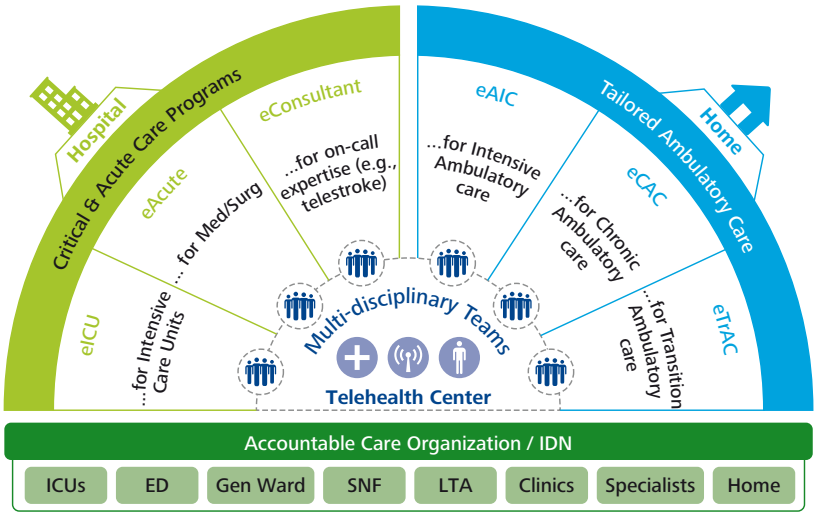
- 26 per cent more likely to survive the ICU
- 16 per cent more likely to survive the hospitalisation and be discharged
- 20 per cent faster discharge from ICU
- 15 per cent faster discharge from hospital.[89]

eAcute offers 24/7 patient care monitoring, leveraging telehealth and a centralised, remote clinical team to augment in-hospital medical/surgical expertise. Powered by the eCareManager software, it helps detect deteriorating patients, targets resource constraints, and addresses readmissions, patient well-being and satisfaction, alongside clinical best practices.

A study comparing eAcute to standard care in a medical/surgical unit found:

- 17 per cent reduction in length of stay
- 16 per cent reduction in cost per case
- 26 per cent reduction in death or discharge to hospital
- 36 per cent reduction in falls.

eConsultant facilitates consultations between remote care teams, bedside care teams and remote clinical specialists, regardless of geography. eConsultant leverages the eICU model and transforms an operational eICU program into a broad-based Telehealth Center.[90]



New entrants to the healthcare provider market

The rise of TEC is also enabling new entrants to enter the provider market operating either as stand-alone providers or in partnership with existing providers. For example, in the US, retail outlet Walmart has opened a series of new primary care clinics, limited to markets where people are uninsured or under-insured, have a high rate of chronic disease or struggle to get access to medical care; as well as places where it has a large number of employees. Visits cost $40 (about half the industry standard) or just $4 for Walmart employees and their families. Increasingly, the clinics are affiliated to, or have partnerships with, their local healthcare systems; enabling them to share data and access patients' EHRs.[91]

In the UK, Babylon, a new app based service launched in May 2014, provides a 'virtual' primary care service, offering a range of health-related services (including access to virtual clinicians, prescription retrieval, and symptom monitoring (using a small monthly subscription based service). The app enables people to schedule an appointment over webcam or send a text with a photo of the problem. Within minutes, a HCP responds to the query. In return, users can rate the quality of their appointed HCP; those who consistently score below-par are no longer employed by the service. After a relatively slow start, over the course of six weeks, some 25,000 new patients signed up for the service.[92]

The expanding role of Apple Inc. in healthcare related initiatives*

In 2014 Apple Inc. developed HealthKit for use on its iOS 8 platform. HealthKit is designed to help users keep better track of their personal health and fitness data, while also tracking fitness trends over a longer period of time. Apple's partnership with the Mayo Clinic, and a growing number of other health institutions, is enabling healthcare providers to receive and transmit data from health checkups, while relying on Apple's privacy protections to ensure security of sensitive records. The appetite for such partnerships appears to be growing.[93]

In March 2015, Apple's launch of ResearchKit in which users decide if they want to participate in a clinical trial and how their data is shared, led to 11,000 candidates enrolling overnight in a cardiovascular study, a feat that would normally take up to a year and involve multiple medical centres around the country. It is an open source software framework gathering data from participants using iPhone® apps. Other research institutions have developed apps with ResearchKit for trials on asthma, breast cancer, cardiovascular disease, diabetes and Parkinson's disease, demonstrating support for new approaches to clinical trials and patient engagement.[94]

Google's expanding role in healthcare related initiatives

In addition to its personal health record platform, Google Health, Google has developed Google Fit, a platform that organises data from various health trackers and sensors. It is also involved in other healthcare innovations, examples include:

- Calico (California Life Company) founded in 2013, focused on aging and age-related diseases which has established a $1.5 billion partnership with pharmaceutical company, AbbVie
- partnering with Novartis, to develop smart contact lenses, that can monitor glucose levels and transmit the information to a doctor via an app to help patients manage diabetes

* Apple is a trademarks of Apple Inc., registered in the U.S. and other countries. Connected Health: How digital technology is transforming health and social care is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc.

- working on a nanoparticle pill to identify cancers, heart attacks and other diseases before they become a problem. Magnetic nanoparticles, less than one-thousandth the width of a red blood cell, circulate through the blood to detect and report signs of cancer or an imminent heart attack.[95]

The pharmaceutical industry: beyond the pill

Pharmaceutical companies are among the most active group of health app publishers, but compared to the importance they have in the traditional healthcare market, their impact in this mHealth market is low. The industry is therefore looking to identify its 'best fit' role in the health app ecosystem. 12 of the leading pharmaceutical companies have published more than 700 apps over the last 5 years but only four companies have attracted a user base of more than 100,000.[96] Opportunities for future developments, include:

- online repeat prescription services
- telemonitoring of compliance
- live dose adjustment based on real time monitoring, through wearables
- early diagnosis, therefore early prescription.

This evolving environment represents an opportunity for the pharmaceutical industry to lead the way on the process of approval of medical apps and devices. Combining its experience of the regulatory approval process and sharing information on the app development and adoption process, should enable the industry to provide national regulating authorities with assurance on quality and safety. In the future the industry could become more of a provider of services by:

- discovering and delivering targeted and precision medicines based on real world evidence of impact
- influencing patients' behaviours 'beyond the pill' and sustaining engagement outside the traditional care setting.[97]

Pharmaceutical companies are among the most active group of health app publishers. The industry is looking to identify its 'best-fit' role in the health app ecosystem.

Part 5. How innovation today might affect healthcare tomorrow

Exponential advancements in science and technology are transforming health and medicine and giving patients more control over their own health. The ability to decode the human genome at an affordable cost is revolutionising our ability to understand disease risks and customise treatments. This, together with improvements in diagnostic scanning and in vitro testing, mean we now know more about human anatomy, opening the way for precision medicines and evidence based approaches to prevention and self-management.

This part of the report considers how some of the emerging mobile technologies available today might impact on future TEC delivery. It also highlights the lack of certainty about tomorrow, due to the scale and volatility of the industry as illustrated by the Digital Health Hype Cycle, developed by Bionicly.

Technological developments

Middleware

Middleware is the name given to the technology that enables data, produced by personal communication devices (for example smartphones), to be incorporated effectively into the healthcare system. It was developed in response to the challenge of managing the huge volume of data generated by alarms and alerts. Middleware facilitates communication and data management enabling applications to communicate effectively. It automates clinical documentation and performs remote surveillance and data aggregation.

Digital imaging

Portable digital imaging equipment is transforming healthcare delivery, from the ambulance to the operating room, making advanced imaging available to patients in remote areas. For example, until recently, ultrasound use was limited by its size, cost and the need for electricity. Now, smaller, affordable, ultrasound machines, some fitting into the palm of a hand, can deliver high resolution imaging often on battery power alone. Use is spreading worldwide, providing state-of-the art mobile enabled imaging to health clinics in remote rural areas.

Innovative digital sensors

A wide range of new digital sensors are in development based on innovative materials, including:

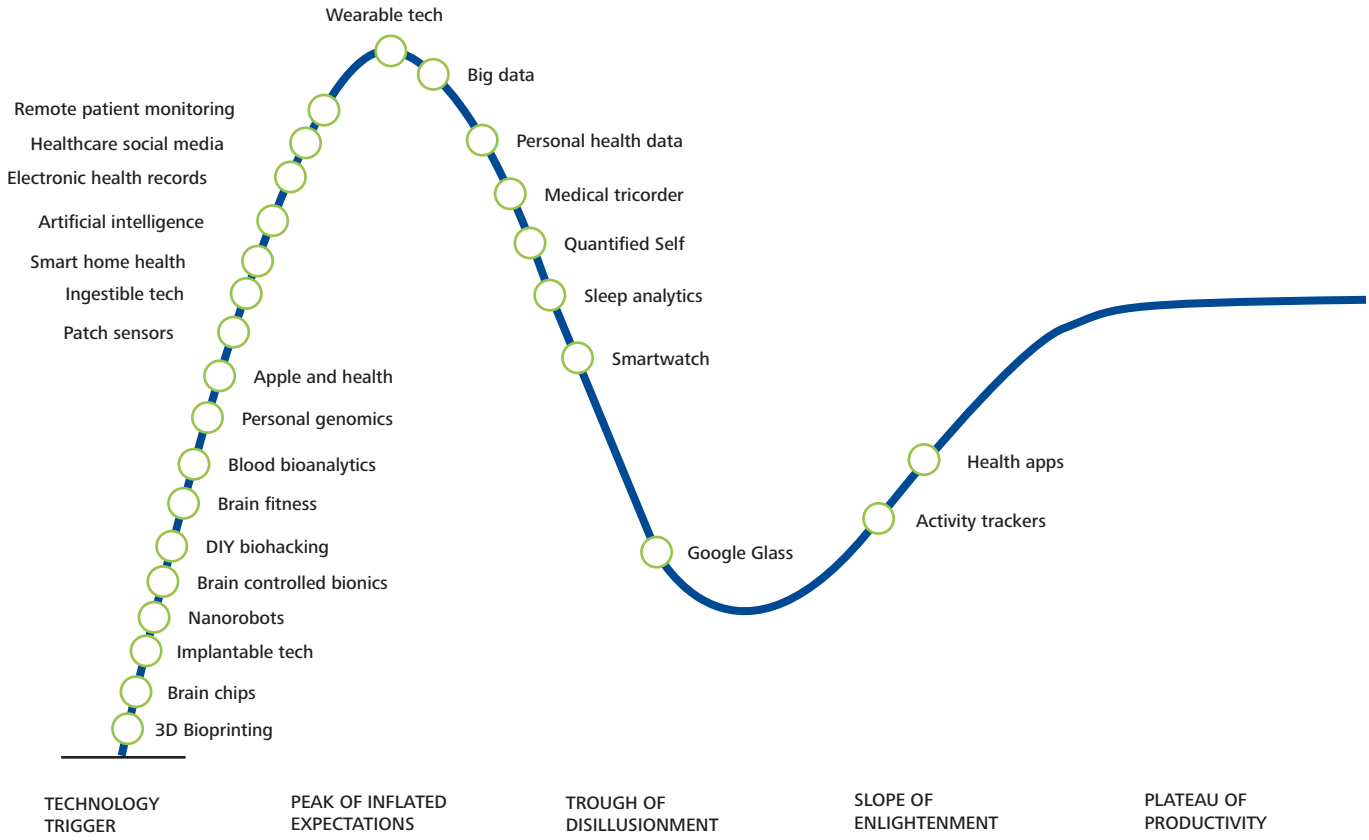
- a new gel-based sticky sensor that monitors electrical activity in the organ without slipping off
- a patch-like sensor that moves with the skin and records and sends health information to synchronised smartphones and computers
- an 'Electronic Skin' sensor worn on the wrist that monitors and treats muscle disorders in people suffering from Parkinson's or epilepsy by detecting tremors and releasing medication embedded in the patch which is absorbed through the skin
- an ingestible sensor by Proteus Digital Health which monitors when a patient has, or has not, taken their medication as well as providing biometric data such as heart rate, sleep patterns, physical activity and stress levels
- TempTraq is a 24 hour single use patch placed under a child's arm which provides a continuous temperature monitor for babies and sends alerts to the child's parent
- HealthPatch, a biometric skin sensor which fits on to a user's chest and tracks heart rate, heart rate variability, respiratory rate, skin temperature, body posture, steps and fall detection/severity and is capable of capturing clinical-grade biometric measurements continuously.

The Hype Cycle for digital health technologies

Given the wide range of new technological developments, predicting how the market will evolve and which technologies will have the most impact on healthcare delivery is challenging. Gartner, a leading information technology research and advisory company, renowned for its graphical methodological tool the 'Hype Cycle', produces an annual illustration of the rate of adoption of specific technologies in different industries.[98] Bionicly, a source of news, information and resources on Digital Health, used Gartner's hype cycle model to create a 2014 digital health version (Figure 12).[99]

Exponential advancements in science and technology are transforming health and medicine and giving patients more control over their own health.

Figure 12. The 2014 Hype Cycle for digital health technologies[100]



Source: Digital Health Hype Cycle, Bionicly, 2014

The industry assessment suggests that some of the more established technologies, such as remote health monitoring are at the top of the 'technology trigger', whereas Google Glass is in the trough of disillusionment. Wearables are at the peak of inflated expectations and big data has actually leapfrogged wearables since the 2013 forecast.

This assessment also suggests that the Connected Home, which is new to the Hype Cycle curve in 2014, could be an important 'innovation trigger', as the industry moves from volume to value payments and the expectations increase for more care to be delivered in people's homes. As the market continues to evolve, these technologies should ideally move further through the cycle with new innovations moving onto the cycle and others failing to progress.[101]

Glossary of terms

Bio-sensing wearables	A biosensor is an analytical device which converts a biological response into an electrical signal and wearables are on or in body accessories that enhance user experience. Biosensing wearables can monitor changes in physiology and the external environment. They are easy to use and provide useful, real-time information by allowing continuous physiological monitoring in a wide range of wearable forms.
eHealth	The transfer of health resources and healthcare by electronic means, encompassing three main areas: • the delivery of health information, for health professionals and health consumers, through the Internet and telecommunications • using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers • the use of e-commerce and e-business practices in health systems management.
Electronic health records (EHR)	A set of records that clinicians control to co-ordinate their team work within and between healthcare teams.
Electronic patient health records (EPR)	A set of records that the patient controls and which allows the patient to work with their clinical team across institutional boundaries.
Mobile health (mHealth)	Medical and public health practice supported by mobile devices (mobile phones, smart phones and tablets), patient monitoring devices, personal digital assistants (PDAs), and other wireless devices. Utilising a mobile phone's core voice and short messaging service (SMS) and more complex functionalities and applications including general packet radio service (GPRS), third and fourth generation mobile telecommunications (3G and 4G systems), global positioning system (GPS), and Bluetooth technology.
Mobile applications (apps)	A software application that can run on a mobile platform (i.e. a handheld commercial off-the-shelf computing platform, with or without wireless connectivity) or a web-based software application that is tailored to a mobile platform but is executed on a server.
Participatory medicine	Patients and clinicians work together to improve the patient's health – in which patients have equal access to all data, are case managers of their own illness and co-producers of their own health. Primary care professionals become gateways not gatekeepers.
Patient portal	A website that gives patients access to the data and information in their electronic health record. Can also be used to book appointments and order repeat prescriptions.
Online patient communities	Online discussion groups allowing patients to learn from peers and professionals including how to understand their own data. They provide access to relevant, timely information and support others with similar conditions.
Personal health records (PHRs)	A set of records that the patient controls and enables users to see who wrote what when and what for.
Technology enabled Care (TEC)	The use of technology to enhance the quality and cost-effectiveness of care and support and improve outcomes for individuals through the application of technology (including, but not limited to, the use of telecare, telehealth, and mobile health and wellbeing) as an integral part of the care and support process.
Telecare	The continuous, automatic and remote monitoring of activity/lifestyle changes over time, providing real time alerts or calls for help in emergencies and helping to manage the risks associated with independent living, enabling people to live independently for longer, particularly those who require a combination of health and social care.
Telehealth and eTelehealth	Telehealth involves the consistent and accurate remote monitoring and management of a health condition including vital signs monitoring. It involves the exchange of information between patient and HCPs to identify trends or changes in the patient's condition, helping to avoid hospital admissions, support early discharge and improve self-care. Telehealth helps educate, train and support people to self-care.
Telemedicine	Telemedicine uses telecommunication and electronic information technologies to provide clinical healthcare at a distance, improving access to medical services and specialists. It permits communications between patient and medical staff as well the transmission of medical, imaging and health informatics data from one site to another. New forms of telemedicine include video-telephony, advanced diagnostics and telemedical devices to support home care.

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