Horizon Scanning Research & Intelligence Centre

New and emerging mobile health interventions that promote behavioural change.

October 2015
The National Institute for Health Research Horizon Scanning Research and Intelligence Centre (NIHR HSRIC) is based at the University of Birmingham in the UK. The NIHR HSRIC aims to supply timely information to key health policy and decision-makers and research funders within the NHS about emerging health technologies that may have a significant impact on patients or the provision of health services in the near future. The scope of our activity includes pharmaceuticals, medical devices and equipment, diagnostic tests and procedures, therapeutic interventions, rehabilitation and therapy, and public health activities.

HSRIC reports can be accessed via our website at: www.hsric.nihr.ac.uk, and the centre can be followed on Twitter at: @OfficialNHSC.

This report presents independent research funded by the National Institute for Health Research (NIHR). The views expressed in this publication are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health.

The NIHR Horizon Scanning Research & Intelligence Centre,
University of Birmingham, United Kingdom

nihrhsric@contacts.bham.ac.uk
www.hsric.nihr.ac.uk

Copyright © University of Birmingham 2015
TABLE OF CONTENTS

EXECUTIVE SUMMARY .................................................................................................................. 5
ACKNOWLEDGEMENTS ................................................................................................................ 6
1. INTRODUCTION AND AIMS .................................................................................................. 7
   1.1 Aims ...................................................................................................................................... 7
   1.2 Definitions .......................................................................................................................... 7
2. BACKGROUND .......................................................................................................................... 9
   2.1 What is driving interest in mHealth? .................................................................................. 9
       2.1.1 Health drivers ............................................................................................................. 9
       2.1.2 Technological drivers ............................................................................................... 10
       2.1.3 Societal drivers .......................................................................................................... 10
   2.2 Application of mHealth technologies ............................................................................ 11
   2.3 mHealth technology landscape ....................................................................................... 12
   2.4 mHealth developers ......................................................................................................... 13
   2.5 mHealth policy & initiatives ............................................................................................ 15
   2.6 mHealth governance ......................................................................................................... 17
       2.6.1 mHealth regulation .................................................................................................. 17
       2.6.2 mHealth evidence base ............................................................................................ 19
       2.6.3 mHealth quality issues ............................................................................................. 19
       2.6.4 mHealth guidance and evaluation ............................................................................ 20
       2.6.5 Horizon scanning mHealth ......................................................................................... 21
3. METHODS ................................................................................................................................. 22
4. RESULTS ................................................................................................................................... 24
   4.1 Summary of questionnaire responses ............................................................................ 24
   4.2 Results categorisation ....................................................................................................... 25
   4.3 Results presentation ........................................................................................................... 26
   4.4 mHealth intervention by category .................................................................................. 26
       4.4.1 Trackers ..................................................................................................................... 26
       4.4.2 Brain training biofeedback ....................................................................................... 28
       4.4.3 Social influence ......................................................................................................... 30
       4.4.4 Complimentary interventions .................................................................................... 30
       4.4.5 Internet of Healthy Things ....................................................................................... 30
       4.4.6 Adherence interventions ............................................................................................ 31
       4.4.7 Skills training and coaching ....................................................................................... 32
       4.4.8 mHealth platforms .................................................................................................... 33
       4.4.9 Gaming/other entertainments ..................................................................................... 34
   4.5 Questionnaire analysis: opportunities and barriers .......................................................... 35
       4.5.1 Potential barriers ...................................................................................................... 35
       4.5.2 Potential opportunities .............................................................................................. 38
EXECUTIVE SUMMARY

This horizon scanning review was requested by Public Health England (PHE) to explore new and emerging mobile health (mHealth) interventions that have potential for use within a defined area of public health. It identifies recently or yet to be released mHealth interventions that encourage behavioural change and/or claim to achieve risk factor reduction in adults; with a focus on healthy eating, physical activity and positive mental health.

The proliferation of mobile technologies and social media has provided a natural opportunity to explore their use in the healthcare setting to deliver population-based interventions that aim to change health-related behaviour. Health need drivers (such as an ageing population) and societal drivers (such as public expectations and a cultural change around the use of personal data) combined with technological and business drivers (including the ubiquity of smartphones) have contributed to the fast growth of the mHealth market and continuous developments of related interventions. The scale of activity in mHealth is vast; there are at the time of writing nearly 100,000 mHealth apps available for download.

A cross-sector steering group of experts contributed to the development of methods used to identify emerging mHealth interventions. A combination of methods was employed including detailed searching of online sources, contacting research funders, following relevant individuals and organisations on Twitter, and a questionnaire to experts in mHealth. Relevant developers identified via the questionnaire were contacted for further information about the interventions that were in development or had recently been made available. Further online searches were conducted to obtain information about identified interventions.

From hundreds of interventions initially identified, further inclusion and exclusion criteria were applied resulting in a total of 94 mHealth interventions selected for inclusion in the review. These were categorised according to a range of acknowledged concepts including type of intervention (e.g. biofeedback) or form of mHealth technology (e.g. wearables). The most frequently identified type of intervention were trackers (both wearable and non-wearable) as well as training and mHealth “platform” based interventions.

The online questionnaire also gathered expert opinion on the opportunities and barriers for the use of mHealth in health services over the next 5 years. These were reviewed and then grouped and presented according to theme. Frequently cited barriers included poor evidence base, lack of consumer/provider engagement, quality issues, lack of health skills and literacy, and cost. Opportunities included patient empowerment, the use of mHealth specifically for diet or exercise interventions and the ubiquity and innovativeness of the interventions on offer.

The discussion highlights the state of the mHealth market and explores the interventions and issues identified in the review. Particular emphasis is placed on the issues mHealth presents for the NHS and the public health agenda. The review concludes that there is a place for using mHealth interventions both within and alongside existing public health programmes but there exists a tension between the characteristics of mHealth (disruptive, innovative and under evaluated) and the current NHS environment (highly regulated, evidence-based and a slow adopter).
ACKNOWLEDGEMENTS

NIHR Horizon Scanning Research and Intelligence Centre review team:

- April Coombe, Horizon Analyst (AC)
- Dr Sue Simpson, Associate Director (SS)
- Dr Annette Wood, Medical Advisor

The following experts contributed to the review:

- Dr Jennifer Martin, Programme Manager, NIHR Mindtech Healthcare Technology Cooperative, The Institute of Mental Health, University of Nottingham.

- Dr Krishnarajah Nirantharakumar, Senior Clinical Lecturer, Institute of Applied Health Research, College of Medical and Dental Sciences, University of Birmingham.

- Professor Jeremy Wyatt, Leadership Chair in eHealth Research, Institute of Health Sciences, University of Leeds.

  Director of the Wessex Institute and Professor of Digital Healthcare, University of Southampton. (from January 2016)

The NIHR Horizon Scanning Research and Intelligence Centre is grateful to all those who helped us to include their professional and user perspective in this report, by giving us their time and providing valuable input.

Statement of conflicts of interest: No statements of conflict of interests have been declared.

We would welcome your views on this report.

Please take our brief online survey at this link:

https://www.surveymonkey.com/s/X7WW6QX
1. INTRODUCTION AND AIMS

We live in an ever changing digital landscape that is allowing rapid global communications and networking to shape and transform modern society. Digital technologies could potentially contribute to addressing many of the health problems and challenges faced by the healthcare sector and the patients it serves.

There are many opportunities to use digital technologies to improve patients’ lives. These technologies are wide ranging and include both hardware and software solutions, from digital hearing aids and monitoring sensors through to services such as clinical decision support systems and the use of digital technologies to provide remote care (telehealth). One of the fastest growing sectors is mobile health (mHealth).

1.1 AIMS

This horizon scanning review aims to identify new and emerging mHealth interventions, including those incorporating social media elements, that claim to encourage behavioural change and achieve risk factor reduction in adults, with a focus on healthy eating, physical activity and positive mental health.

Given the rapid development of mHealth interventions and characteristics of the technology and market, an attempt to identify all relevant technologies was not feasible. Instead an overview of the mHealth interventions, currently available or emerging, is provided. In addition, examples of interventions that may not yet have been applied to prevention or wellness, but have potential for such, are included.

1.2 DEFINITIONS

Definitions are included below for terms specifically referred to in the aims. A glossary of terms used throughout the review can be found in Appendix 1.

mHealth: the use of mobile technologies to deliver healthcare interventions. These technologies could include mobile phones, patient monitoring devices, tablets, wearable technology, sensors, other wireless devices as well as software (including apps). mHealth is a relatively new concept and definitions vary1. The following definition highlights the value of the mobility of the technology and is useful in distinguishing mHealth interventions from those interventions that can be delivered by a variety of mechanisms including mobile (e.g. web or TV):

“a service or application that involves voice or data communication for health purposes between a central point and a remote location. It includes telehealth (or eHealth) applications if delivery over a mobile network adds utility to the application. It also includes the use of mobile phones and other devices as platforms for local health-related purposes as long as there is some use of a network”2.

The emphasis in this review is on those interventions for which mobile delivery is an essential part of the package rather than a delivery option.
Mobile technologies may be:

a) New technologies; anything from a new wearable technology, to new software applications.

b) Innovative combinations and/ or modifications of existing technologies.

**Social Media:** “A group of Internet-based applications that build on the ideological and technological foundations of Web2.0 and that allow the creation and exchange of user generated content⁴. Social media technologies may include internet fora, blogs, microblogs, collaborative projects, social gaming elements, social bookmarking, social networks and image broadcasting. Examples of social media include Facebook, Twitter, YouTube, Flickr and Google+.

**Healthy eating:** eating a nutritionally balanced diet to include at least five portions of different types of fruit and vegetables a day as recommended to the general adult population⁴.

**Physical activity:** exercise levels recommended by the NHS for adults⁵.

**Positive mental health:** the maintenance and promotion of good mental health through relaxation, mindfulness, sleep training and other related techniques within the general adult population.

**Behavioural change:** The report uses Professor Susan Michie’s⁶ framework for characterising and designing behavioural change interventions (Table 1).

**Table 1: Aspects of behavioural change interventions**

<table>
<thead>
<tr>
<th>1. Education</th>
<th>Increasing knowledge or understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Persuasion</td>
<td>Using communication to induce positive or negative feelings or stimulate action</td>
</tr>
<tr>
<td>3. Modelling</td>
<td>Providing an example for people to aspire to or imitate</td>
</tr>
<tr>
<td>4. Environmental restructuring</td>
<td>Changing the physical or social environmental promoters or barriers</td>
</tr>
<tr>
<td>5. Incentivisation</td>
<td>Creating expectation of reward</td>
</tr>
<tr>
<td>6. Coercion</td>
<td>Creating expectation of punishment or cost</td>
</tr>
<tr>
<td>7. Enablement</td>
<td>Increasing means/reducing barriers to increase capability beyond education and training</td>
</tr>
<tr>
<td>8. Training</td>
<td>Imparting skills</td>
</tr>
<tr>
<td>9. Restriction</td>
<td>Using rules to reduce the opportunity to engage in the target behaviour</td>
</tr>
</tbody>
</table>

Source: [http://www.behaviourchangewheel.com/about-wheel](http://www.behaviourchangewheel.com/about-wheel)
The mHealth landscape is evolving fast and the potential for mHealth delivered interventions to impact on health in a variety of ways is being realised and commercially exploited. There is a high level of interest in mHealth and its future development from a broad range of sectors including academia, charities, the NHS (including the public health and prevention programmes) as well as a wide range of commercial businesses (health, technology, clothing etc.). Given that there is interest across many sectors it is likely that mHealth users may be introduced to mHealth interventions from outside the healthcare sector.

2.1 WHAT IS DRIVING INTEREST IN MHEALTH?

The drivers and opportunities for mHealth are numerous and converging and include:

2.1.1 HEALTH DRIVERS

- **Personalised care and co-design of care between patient and clinician.** mHealth has the potential to assist in providing appropriate programmes either based around algorithms or healthcare provider input that tailor care to individual requirements. There are also enhanced opportunities for clinician and patient to agree on care plans and targets and set goals, which can be monitored and evaluated through regular communication and data sharing via mHealth technologies and traditional communications.

- **Hard to reach groups.** mHealth provides an opportunity to access users in a very different way. Opportunities for working with hard to reach groups, who traditionally engage less with healthcare providers, may be a possibility.

- **Potential to complement traditional therapies.** mHealth interventions could be offered to patients waiting to start, or in-between, face-to-face therapy, for example mental health services where waiting lists may be lengthy.

- **Rising healthcare costs.** According to a report in 2013 by the Kings Fund, if the next 50 years follow the trajectory of the past 50, then by 2062 the United Kingdom could be spending nearly one-fifth of its Gross Domestic Product (GDP) on the NHS. If mobile technology can enable early intervention and encourage a healthy lifestyle, this could help the prevention agenda, thus reducing costs. Contributing cost factors include:
  - **An ageing population.** There are now 11.4 million people in the UK aged 65 and above. Linked with this is a corresponding increase in prevalence of chronic disease. mHealth may offer cheaper solutions for remote consultation, monitoring, prevention and management of symptoms.
  - **The impact of “Western” lifestyles.** This has seen an increase in chronic conditions such as heart disease, diabetes and certain
cancers. mHealth could have a role to play in encouraging behavioural change through well-being apps, information provision, self-help and intelligent public health systems to limit the effect of these lifestyles.

2.1.2 TECHNOLOGICAL DRIVERS

- **Increased mobile technology usage.** In 2015, 93% of UK adults said they owned a mobile phone, with 66% owning a smartphone. Forecasts estimate that by 2017 there will be 43.4 million users of smartphones in the UK.

- **Big data potential.** mHealth could assist in health data collection and analysis, which could in turn help inform policy makers. If patient generated data from fitness trackers can be fed into patient information management systems, this could allow healthcare providers to gather broad indicators on some key patient metrics such as activity levels.

Both Apple and Google have ongoing research projects in this area. Apple’s ResearchKit provides a framework for building apps and for recruiting people to clinical trials whilst Google “Baseline” study aims to track a small number of healthy individuals eventually designing and developing new wearable technology to monitor the health of participants in the study.

2.1.3 SOCIETAL DRIVERS

- **Public expectation.** A rising expectation from the public as to what is possible has been fuelled by media coverage of the digital sector. The public are aware of smart watches, clothes and sensors that claim to improve health in some way, and of the possibilities for change within healthcare provision.

- **Cultural change around the use of personal data.** An ongoing cultural shift around the “quantified self” movement sees issues around individual privacy often given less prominence. This willingness to quantify and “self-publish”, feeds into the self-care concept with the patient actively or passively monitoring their own bodies. The MiData Studio feasibility report from the Digital Technology Catapult looks at providing a model for innovating with personal data that could have application for health as well as other local community issues.
## 2.2 APPLICATION OF MHEALTH TECHNOLOGIES

mHealth can be applied across the healthcare pathway (Table 2).

### Table 2: mHealth by sector

<table>
<thead>
<tr>
<th>mHealth Sector</th>
<th>Examples</th>
<th>Estimated global share of mHealth market by 2017[^15]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention</td>
<td>Information, counselling, training, gaming, social support, biofeedback or other type of intervention provided by a remote connection.</td>
<td>4% or $0.9 billion</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Remote connection to allow patient self-assessment[^16].</td>
<td>15% or $3.4 billion</td>
</tr>
<tr>
<td>Treatment</td>
<td>Remote connection with health professional combined with self-management and self-reporting.</td>
<td>10% or $2.3 billion</td>
</tr>
<tr>
<td>Healthcare system improvement/ administration</td>
<td>Short Messaging Service (SMS) reminders, self-booking appointments via mobile networks, electronic patient records accessed through a mobile device network.</td>
<td>1 % or $0.1 billion</td>
</tr>
<tr>
<td>Health research and surveillance support</td>
<td>Using “Big Data” generated by mHealth technologies as well as existing health data-collection mechanisms to track disease outbreaks, epidemics and pandemics. Mapping obesity and dietary issue hotspots.</td>
<td>&lt;1% or $ 0.1 billion</td>
</tr>
<tr>
<td>Health practitioner support</td>
<td>Mobile access to just-in-time knowledge, learning, performance tracking, social networking, care co-ordination, checklists, work planning, patient registration.</td>
<td>5% or $1.1 billion</td>
</tr>
<tr>
<td>Emergency care</td>
<td>Devices that can monitor conditions remotely and alert carers or healthcare professionals to respond quickly e.g. accelerometers and pressure sensors could be used to predict and/or respond to falls in the elderly. To support victims and professionals.</td>
<td>0% or $0 billion</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Patient monitoring through appropriate apps, sensors, social networking and mobile communication.</td>
<td>65% or £15 billion</td>
</tr>
</tbody>
</table>

[^15]: Estimated market share and revenue figures are based on historical data and projections from various market research reports and analysis. The specific percentages and amounts may vary depending on the source and methodology used.

[^16]: Self-assessment tools can include questionnaires, surveys, and assessment tools that can be completed at home or online, allowing individuals to assess their own health status and make informed decisions about their healthcare.
2.3 MHEALTH TECHNOLOGY LANDSCAPE

The mHealth marketplace covers a wide range of technologies including hardware (e.g. mobile phones) and software (e.g. apps). Many of these technologies are being harnessed in various combinations to provide a range of interventional solutions. These interventions can be categorised from a number of perspectives and a definitive method of categorisation has yet to emerge.

The US National Telehealth Resources Centre provides some useful definitions\textsuperscript{17} to help understand this area. Table 3 builds on these to provide a categorisation of the technologies in the marketplace relevant to the project scope. Whilst this categorisation is unlikely to be exhaustive, it provides a current snap-shot of a constantly evolving market.

**Table 3: mHealth technologies by type**

<table>
<thead>
<tr>
<th>Category of product</th>
<th>Examples of potential intervention</th>
</tr>
</thead>
</table>
| Short Message Service (SMS) based services | • Appointment reminders  
  • Intelligent targeted public health messaging                                                        |
| Real-time voice communication              | • Voice calls to support wellness and prevention programmes to enable the remote professional/patient or user relationship |
| Special purpose applications               | • Apps to improve sleep, mental health, adherence to medicines, diet and exercise-related behaviours  
  • Health data aggregation platforms e.g. a computer platform that combines several of these functions into a single “health” monitoring product (little data)  
  • mHealth open source software (tools for mHealth interventions)                                           |
| Cameras/digital video recorders            | • For image sharing or video conferencing within the health ecosystem, e.g. as part of a wellness or prevention programme |
| Sensors                                    | By function:  
• Alcohol sensor  
• Pulse oximeter  
• Brain wave sensors  
• Electrodermal activity sensors (stress/sweat detectors)  
• Spirometers  
• Accelerometers  
• Medicine compliance trackers  

By format:  

**Wearables:**  
• Bracelets/watches  
• Belts  
• Headsets  
• Ear plugs/buds  
• Items of clothing  
• Glasses  
• Contact lenses  
• FootPods and pedometers
mHealth technology standards have yet to emerge. Interoperability, categorisation and definitions for mHealth are in development.

The following pieces of work aim to encourage interoperability for mHealth technologies:

- An mHealth roadmap published in 2013 by the Healthcare Information and Management Systems Society (HIMSS)\textsuperscript{18}.
- The British Standards Institute has published a set of standards to support developers creating health and wellness apps\textsuperscript{19}.
- The Open mHealth is a not for profit organisation working in the area of standards and interoperability and has developed a set of data schemas that provide guidelines for structuring different types of digital health data optimally for clinical use\textsuperscript{20}.
- A Harvard lead project, Substitutable Medical Applications, Reusable Technologies (SMART), provides a platform which allows apps to connect to various electronic health records (EHR)\textsuperscript{21}.

### 2.4 MHEALTH DEVELOPERS

The marketplace is busy and dynamic with many types of developers bringing products to market (Table 4). The type of developer may have an impact on market penetration, support to users and incremental developments or add-ons.
Table 4: mHealth by type of developer

<table>
<thead>
<tr>
<th>Category of business</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual developers</td>
<td>There are toolkits now available that allow anyone to develop simple mHealth apps. For example MIT App Inventor Toolkit or the eHealth shield and sensors for Arduino microcontrollers.</td>
</tr>
<tr>
<td>Start-ups</td>
<td>There are many start-up businesses operating in the market. Often looking for crowdfunding/angel investors via websites such as Indiegogo and Kickstarter.</td>
</tr>
<tr>
<td>Partnerships</td>
<td>Businesses go into partnerships to exploit their areas of expertise more effectively.</td>
</tr>
<tr>
<td></td>
<td>For example, US health insurer start-up Oscar Health is teaming up with Misfit Wearables. As part of the deal, each Oscar member will get a free Misfit Flash tracker and the opportunity to earn up to $20 a month in Amazon.com credit by meeting step goals. The more steps users take the more money Oscar will give.</td>
</tr>
<tr>
<td>Established pharma/med tech companies</td>
<td>For example “Track your health” a tracker/data-aggregator/platform from Johnson &amp; Johnson and available via employee wellness programmes.</td>
</tr>
<tr>
<td></td>
<td>Pharma App Benchmarking report (2014) stated that given the dominance of these big pharma companies they have not yet been able to translate this into the download business that some smaller players have achieved.</td>
</tr>
<tr>
<td>Established, global IT companies</td>
<td>Google (Googlefit), Microsoft (mHealth platform and smartband) and Nintendo (Sleep Sensor) are all launching products in this marketplace.</td>
</tr>
<tr>
<td></td>
<td>There has also been the acquisition of smaller specialist companies by big IT players to gain expertise and entry points to the mobile market e.g. Facebook buy out of Oculus (makers of Oculus Rift – a virtual reality gaming headset).</td>
</tr>
<tr>
<td>Existing mobile device manufacturers</td>
<td>Recent announcements include LG SmartHealth and Apple’s HealthKit announcement which included Mayo Clinic and Epic.</td>
</tr>
<tr>
<td></td>
<td>Samsung have been releasing updates of their S Health app as well as:</td>
</tr>
<tr>
<td></td>
<td>- Simband an “Investigational Device” containing a variety of health sensors and</td>
</tr>
<tr>
<td></td>
<td>- “SAMI” a data broker that Simband type devices and other third party health tracking devices could upload data to, which could then be used by developers to create new apps.</td>
</tr>
<tr>
<td>Other</td>
<td>Sports and fitness companies are seeking entry points to the mHealth market through wearables such as smart shirts or other tracking devices.</td>
</tr>
<tr>
<td></td>
<td>Fashion and jewellery companies are looking at the smart wearable products market.</td>
</tr>
<tr>
<td>Academic/third sector</td>
<td>Academic and third sector institutions are starting to develop expertise in this area. Many have received funding to develop mHealth solutions. These developments tend to be well reported in the academic press and contribute to the growing evidence base around mHealth.</td>
</tr>
</tbody>
</table>
2.5 MHEALTH POLICY & INITIATIVES

Although this is a relatively new area of development, the NHS and UK Government are starting to explore approaches incorporating mHealth and to invest in developments in digital technologies including mHealth.

Key strategies include:

- **The Internet of Things: making the most of the Second Digital Revolution**: A report by the Chief Scientific Advisor published by the UK Government at the end of 2014. It covers the use of 'Internet of Things' products in healthcare and potential for use in prevention, early identification and research. Issues such as data security, hardware security and change management are discussed24.

- **Personalised Health and Care 2020**: A report published by the UK Government in November 2014. It takes the form of a framework document designed to support frontline staff, patients and citizens to take better advantage of digital opportunities. It includes a recommendation that the NHS should allow relevant apps to be branded with the NHS logo, some of which could then be recommended to patients25.

- **NHS England. The NHS Five Year Forward View**: Published in October 2014 the report sets out a vision for the future of the NHS which has a heavy focus on public health issues and the prevention agenda, as well as supporting the development of accredited health apps26.

- **Delivering the Five Year Forward View**: This report was published in June 2015 by the National Information Board (NIB) and reiterates the intention for the development of an accredited digital applications library27.

Ongoing Government initiatives include:

- Improvements to the **Technology Enabled Care Services** (TECS) to help empower patients and improve health outcomes through existing and emerging technologies28.

- Further development of the **Integrated Digital Care Fund** to support the integration of diverse information sources around the patient29.

- The commissioning of an **Innovative Medicines and Medical Technology Review** to look at how medical innovations (including health apps) can be developed to provide quicker access to patients30.

Initiatives to stimulate innovation in mHealth include:

- **Public Health England** in August 2014 announced the winners of “Health X competition” which invited submissions on mobile technologies designed to monitor and improve health31.

- **techUK** in February 2015 announced the winners of “UK Best Mobile Health-App Competition”32.

- **Innovate UK** are running a ‘Wearable technologies innovation contest’ supported by leading industry partners who have each set broad challenges to encourage commercial, creative and technical innovation; exploring the
themes of hospitality, entertainment, design, sport and wellbeing, health and safety, and accessibility.

- The **NHS Integrated Digital Care Fund** aims to support projects that capture and link clinical and care information in digital care records within NHS Trusts and Foundation Trusts, and between NHS Trusts/Foundation Trusts and local authorities. It shows awareness of the need to look to the future of patient-generated data to leverage the potential offered by third party mHealth solutions and how these may integrate with NHS systems. “As more patient insight and patient-generated data emerges, models of care, and the information systems upon which they depend, must flex and adapt to incorporate this rich resource”.

- The **NHS Nursing technology fund** covers a range of digital and mobile projects.

- The **UCL festival for Digital Health** held in June/July 2014 included a gamification and self-tracking in health and wellbeing event with a prize of £10,000 worth of app development.

- The **Research Councils UK** have a “Digital economy” portfolio with some relevant sub streams including “Sustainable Society: Towards sustainable behavioural change through digital technology”.

- The **Engineering and Physical Sciences Research Council** published in March 2015 its new Healthcare Technology Strategy for the next five years.

There are also several networks operating to support digital and mHealth innovation including:

- **MindTech** - an NIHR funded health technology cooperative that aims to bring together patients, clinicians, researchers and industry to develop and test a range of new digital technologies to support mental health.

- **West Midlands Health Informatics Network** - a regional network that supports digital health innovation.

- **Academic Health Science Networks** - work in partnership with NHS England and the UK Government to implement local ‘test beds’ to trial new ways of improving care for patients (as part of NHS Five Year Forward View) including mHealth technologies, such as wearable devices.

- **Collaborations for Leadership in Applied Health Research and Care** (CLAHRCs) - have a role to play in the support of innovation with some CLAHRCs funding mHealth projects.

- **HANDI** - a not-for-profit body that organise seminars and publishes position papers on digital technologies in health.

- **Digital Health and Care Alliance** - provides support through events and publications.
2.6 MHEALTH GOVERNANCE

Governance issues surrounding mHealth interventions are being highlighted across multiple organisations and authorities. Mobile apps are at the forefront of these discussions, given their proliferation.

In a White Paper published in March 2014 based on a seminar held at the Kings Fund ("Health Apps: Where do they make sense") it was concluded that:

“No single entity of section of society seems equipped to take on the role of sole arbiter of quality standards” and that the “Likelihood is that several bodies (including patients/the public) might take on joint responsibility for curating the trustworthiness of apps”

2.6.1 MHEALTH REGULATION

Given the relative infancy of mHealth, how it is regulated as a healthcare intervention is still being established. Some technologies will fit within established regulatory pathways but for others, in particular apps, this is unlikely to be the case.

In the US, mHealth developers must consider the Health Insurance Portability and Accountability Act (HIPAA) designed to protect the privacy of individually identifiable health information. They need to establish whether the software will be used by a covered entity, such as a registered healthcare provider, and whether it will include any protected health information. An application that assists a healthcare provider in following up a healthcare user would need to be designed to allow the physician to comply with HIPAA. In contrast, an application that is for use by a healthcare user alone would not need to comply; even if the application permitted the user to send information to her physician, although the information would become subject to HIPAA once the HIPAA-covered healthcare provider received it. While health-related applications that are not used by covered entities or business associates are not subject to HIPAA, they may be subject to other privacy and security laws.

The following regulatory agencies have produced outputs relevant to MHealth:

- Medicines and Healthcare Products Regulatory Agency (MHRA):
  - March 2014 - guidance on medical device stand-alone software (including apps). It distinguishes those devices that interpret patient data or provide personalised information based on patient data as being medical devices. Those apps that are considered medical devices will be required to undergo a conformity assessment, the exact pathway for this assessment will be dependent upon the classification of the device e.g. Class IIa or Class IIb. This guidance highlights the contextual nature of what is considered a medical device. For example, an application may be considered a medical device if it is being used for a medical purpose but the same application used in a social care or sports and leisure context would not be considered a medical device.

- European Commission (EC):
  - March 2014 – released a draft of its General Data Protection Regulation to replace the previous Data Protection Directive. The Data Protection Directive is a European Union Directive, which was created to regulate the processing of personal data within the European Union.\(^47\)
  - April 2014 – Green Paper published on mobile health which asks a number of questions to those working in digital health on safety, security and performance requirements for lifestyle and wellbeing apps.\(^48\)
  - July 2014 – updated its “Manual on borderline and classification in the community regulatory framework for medical devices”\(^49\) to include a section on software and mobile apps. The updated manual is not legally binding, and it is up to the national competent authorities and national courts to makes classification determinations on a case–by–case basis if challenged.\(^50\)
  - January 2015 – Summary report on the public consultation on the Green Paper on mobile health published.\(^51\)

- US Food and Drug Administration (FDA):
  - August 2014 – proposed to largely deregulate a sizable list of Class II and Class I medical devices such as thermometers, smart body scales and stethoscopes, all of which would remove barriers for mHealth developers.\(^52\)
  - February 2015 – guidance on mobile apps for which enforcement discretion may be exercised. This guidance employs a risk based approach that allows the agency to focus its regulatory oversight on mobile medical apps that present greater risk to patients if they do not work as intended. It takes the form of recommendations only and is not currently legally enforceable.\(^53\)
  - February 2015 – draft guidance on general wellness policy for low risk devices and medical device accessories. According to the FDA website they will “continue to clarify which medical devices are of such low risk that we will no longer focus our regulatory oversight on them or we will regulate them under a lower risk classification, narrowly tailoring our approach to the level of risk to which patients or consumers are exposed.”\(^54\)
  - February 2015 – published a final version of its “Medical Device Data Systems, Medical Image Storage Devices, and Medical Image Communications Devices” guidance which is focused on “making medical devices interoperable with other types of medical devices and with various types of health information technology. The foundation for such intercommunication is hardware and software that transfer, store, convert formats, and display medical device data or medical imaging data”, for example, software that stores historical blood pressure information for later review by a healthcare provider.\(^55\)
2.6.2 MHEALTH EVIDENCE BASE

The evidence base for mHealth interventions is patchy but growing. There is some evidence to suggest that SMS messages may present a convenient and cost–effective method to support healthcare interventions and bring about behavioral change. In particular, a 2013 systematic review concludes that text messaging may be an effective intervention for smoking cessation. As to be expected, for more recently developed mHealth interventions the evidence is sparser.

It is outside the scope of this report to provide a systematic review of the mHealth evidence base.

2.6.3 MHEALTH QUALITY ISSUES

In the White Paper Health Apps: Where do they make sense (March 2014) issues around the need to update medical information contained within mHealth interventions to reflect the ever changing evidence base are highlighted:

“Health apps face significant challenges if they are to maintain high quality throughout their time in the marketplace. Medical information quickly becomes superseded; the regulatory environment is reformed or adapted; changes sweep away other elements of the systems in which health apps work. Health apps need to be upgraded to reflect external change, but app developers (and their funders) – find the remodelling of apps to be both time-consuming and costly. As such, one possible unfortunate consequence of implementing quality standards for health apps could be higher prices of the products for users, undermining a key virtue of health apps–their accessibility to the public.”

Given the infancy of the regulatory environment and lack of established pipeline the quality and safety of some of the mHealth interventions in the marketplace is poor.

For example:

- The Samaritans decided to suspend its 'suicide watch' app when the app (which used an algorithm to identify key words and phrases which could denote mental stress) caused controversy by prompting claims that it left some people with mental health issues feeling more rather than less vulnerable.
- FDA approval has not been obtained for many apps that use sensor technology to take blood pressure readings.
- mHealth solutions do not always follow clinical guidance or best practice. A range of smoking cessation apps was reviewed and it was demonstrated that these apps would be improved if they adhered to evidence based guidance (American Journal of Preventative Medicine, 2013).
A variety of guidance and evaluative tools exist to assist those both developing and using some of the mHealth technologies which have been developed. These have, to date, largely focused on mobile phone apps. Listed below is a selection:

- **The British Standards Institute** (UK) has published a set of standards to support developers creating health and wellness apps which outline a set of principles that app developers should follow, to make sure that their products and services can be trusted by healthcare professionals and the public\(^\text{19}\).

- **The Centres for Disease Control and Prevention** (USA) *Social Media Tools, Guidelines & Best Practices* toolkit focuses on the social media side of any mHealth technologies to be considered\(^\text{62}\).

- **MindTech, The University of Leeds and Leeds and Yorkshire NHS Foundation Trust** (UK) are developing a common set of criteria for evaluating digital mental health products including apps and websites\(^\text{63}\).

- **The National Information Board** (UK) is developing an app assessment process to be piloted autumn 2015 with a beta version scheduled for release at the start of 2016. It is proposed that the assessment is made via a four step framework including self assessment, community evaluation, benefit case and independent impact assessment\(^\text{64}\).

- **NHS Choices Apps Library** (UK) is the subject of a reviews process to ensure only apps that meet certain quality standards are included in the library. This process is in its early stages of development and will be adapted over time. At the moment all apps submitted are checked to make sure that they are relevant to people living in England, comply with data protection laws and comply with trusted sources of information, such as NHS Choices. Once an app has met these minimum requirements it is checked to see whether the app could potentially cause harm to a person’s health or condition, and a clinical assurance team work with the developer to make sure the app adheres to the teams’ safety standards\(^\text{65}\). In March 2015 the Mental Health Apps Library launched as part of the NHS Choices Apps library. It lists apps selected because of the evidence-base around digital tools as interventions for mild to moderate depression and anxiety\(^\text{66}\). According to NHS England, this work will feed into the National Information Board’s (NIB) work to formally endorse and accredit digital services for use in clinical practice\(^\text{64}\).

- **My Health apps** (UK) Website curated directory of apps that have been tested by patients\(^\text{67}\).

- **European Directory of Health Apps** (Europe) A directory of health apps from across Europe\(^\text{68}\).

- **Our mobile health** (UK) An app reviewing service and website\(^\text{69}\).

- **Oxford Academic Health Science Network (AHSN)** in conjunction with NHS Innovations South East have produced a roadmap for those wishing to develop apps for health\(^\text{70}\).
Against this background of a fast moving technology that has potential to change approaches to healthcare, particularly prevention, Public Health England asked the NIHR HSRIC to carry out an horizon scanning review to identify key emerging mHealth interventions that encourage behavioural change and achieve risk factor reduction in adults with a focus on healthy eating, physical activity and positive mental health.
3. METHODS

The methods for this review were determined by the characteristics of the technology and its developers; and the state of the market. Unlike other healthcare interventions such as pharmaceuticals, mHealth technologies lack an established pipeline, can be extremely quick and cheap to develop (very low barriers to market entry) and are being developed by a range of companies and individuals without established regulation.

An advisory group, consisting of experts working in the area of mHealth, was established and an initial teleconference held in May 2014. Following this a combination of methods was agreed to identify emerging mHealth interventions:

1. Searching a wide range of online and in-house sources of intelligence including:
   - Health technology horizon scanning databases, e.g. the internal NIHR HSRIC database, and members’ access only international horizon scanning databases such as EuroScan.
   - Relevant conference reports and abstracts.
   - Review articles and commentaries in relevant specialist journals.
   - Websites and publications of key specialist organisations.

These were supplemented by a search via Google, health media reports and industry news. Searching took place between October 2014 and January 2015 with additional material from select sources incorporated up until May 2015. A full list of identification sources and search terms used are provided in Appendix 2.

2. Experts from academia and the third sector were asked to identify new and emerging mHealth interventions and/or relevant developers via an online questionnaire. The questionnaire also sought their opinion on the opportunities and challenges around the future of mHealth.

Potential experts and networks were identified by:
   - Searching conferences and events speaker listings on mHealth (see Appendix 2).
   - Searching UK academic institutes or schools/colleges in Biomedical Engineering, Health Informatics, Behavioural Psychology and Public Health for academics with an interest in mHealth (see Appendix 2).
   - Searching organisational websites including WHO mHealth technical advisory group, mHealth Alliance staff, Digital Health coalition partners/advisory board. (see Appendix 2).
   - Snowballing – contacting an expert recommended by the advisory group, who recommended further experts, who provided further information in terms of papers, experts or access to networks.
   - Networks identified via the advisory group (see Appendix 2).
   - Searching Academia.Edu on "mHealth" for listed academics from Europe, America and Australia tagged under mHealth, excluding PHD students.
3. Following individuals and organisations with an interest in mHealth on Twitter and then searching these accounts for topics related to behavioural change for public health (see Appendix 2).

4. Contacting funders of related research and asking them about funding opportunities in mHealth (see Appendix 2).

The following mHealth interventions were excluded at point of search:

- Disease monitoring and management interventions e.g. monitoring triggers for, and frequency of, asthma attacks to inform management/treatment.
- Interventions where providing information to patients was the primary function.
- Basic tracking technologies e.g. pedometer.
- Augmented or enhanced display apps e.g. text spacing apps for dyslexia.
- Foreign language interventions.
- Non–healthcare related interventions.
- mHealth interventions concerned with healthcare worker training, remote data collection, remote monitoring, supply chain management, disease and epidemic outbreak tracking and diagnostics.

Identified mHealth interventions were then filtered against the following criteria:

- Is the mHealth intervention’s primary function concerned with wellness and prevention? If not, does the product have potential application for wellness and prevention?
- Can a behavioural change element be identified?
- Was the mHealth intervention launched prior to 2014, if so has the technology been substantially altered since initial launch?
- Is the mHealth intervention currently either yet to launch, in pilot phase or not yet widely in use in the UK healthcare sector?
- Does mobility add utility to the mHealth intervention?

Technologies were filtered by a researcher (AC) with cross checks undertaken by a second researcher (SS).

Developers were contacted to provide further details on the interventions in question if required.
4. RESULTS

The mHealth interventions identified for this horizon scanning review came from multiple sources with some interventions being repeatedly identified. From hundreds of mHealth interventions initially identified 94 were included in the review as having met the inclusion criteria.

4.1 SUMMARY OF QUESTIONNAIRE RESPONSES

There were 125 questionnaire responses: 59 mHealth interventions were identified, 10 of which met our inclusion criteria.

The filtration of mHealth interventions and developers identified via the questionnaire is summarised in Table 5.

**Table 5: Interventions and developers identified via questionnaire**

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of questionnaire responses</td>
<td>125</td>
</tr>
<tr>
<td>Total number of respondents aware of innovative mHealth interventions being developed to promote wellness through encouraging behavioural change in diet/exercise or promotion of good mental health that are not yet widely available in the UK.</td>
<td>70</td>
</tr>
<tr>
<td>Total number of respondents aware of academic units, organisations or companies active in developing mHealth interventions.</td>
<td>49</td>
</tr>
<tr>
<td>Number of Interventions identified via questionnaire respondents.</td>
<td>59 (Of these 10 met the inclusion criteria.)</td>
</tr>
<tr>
<td>Number of potential developers identified.</td>
<td>53</td>
</tr>
<tr>
<td>Number of developers contacted for further information identified via questionnaire.</td>
<td>41</td>
</tr>
</tbody>
</table>

All other interventions and developers were identified by searching sources using search terms outlined in Appendix 2.
4.2 RESULTS CATEGORISATION

All 94 mHealth interventions were categorised and then listed (Appendices 3–12). Given the absence of a formal categorisation of mHealth interventions, a means of categorising them was developed (Table 6). Many mHealth interventions contain a variety of technologies which made categorisation along technical lines problematic. The categorisation used was therefore based on a mix of acknowledged concepts including:

- A type of intervention, for example, “skills and training”.
- A way of looking at how an intervention is employed, for example, “companion” interventions (designed to be used in conjunction with other therapies).
- The format of the mHealth intervention in question, for example, wearable.

Some mHealth interventions could sit comfortably in several categories but, for purposes of manageability, have been placed in a single category for which they have a close match.

Table 6: mHealth solutions identified by category

<table>
<thead>
<tr>
<th>Category of mHealth intervention</th>
<th>Number identified</th>
<th>Appendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearable trackers subdivided into</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bands, bracelets and watches</td>
<td>16</td>
<td>Appendix 3</td>
</tr>
<tr>
<td>Internal/implantable wearables</td>
<td>1</td>
<td>Table 1</td>
</tr>
<tr>
<td>Smart Clothes</td>
<td>5</td>
<td>Table 2</td>
</tr>
<tr>
<td>Tracking headsets and earplugs</td>
<td>2</td>
<td>Table 3</td>
</tr>
<tr>
<td>Other wearables</td>
<td>3</td>
<td>Table 4</td>
</tr>
<tr>
<td>Non-wearable trackers</td>
<td>12</td>
<td>Appendix 4</td>
</tr>
<tr>
<td>Brain training biofeedback interventions</td>
<td>6</td>
<td>Appendix 5</td>
</tr>
<tr>
<td>Social influence interventions</td>
<td>6</td>
<td>Appendix 6</td>
</tr>
<tr>
<td>Complimentary interventions</td>
<td>6</td>
<td>Appendix 7</td>
</tr>
<tr>
<td>“Internet of Healthy Things” products</td>
<td>4</td>
<td>Appendix 8</td>
</tr>
<tr>
<td>Adherence interventions</td>
<td>9</td>
<td>Appendix 9</td>
</tr>
<tr>
<td>Information, training and coaching</td>
<td>10</td>
<td>Appendix 10</td>
</tr>
<tr>
<td>mHealth platforms</td>
<td>10</td>
<td>Appendix 11</td>
</tr>
<tr>
<td>Gaming/other entertainment</td>
<td>4</td>
<td>Appendix 12</td>
</tr>
</tbody>
</table>
4.3 RESULTS PRESENTATION

Each category heading provides:

- A brief introduction and description which includes its likely applications within public health topics of interest (e.g. positive mental health).
- Examples of established mHealth interventions in this area.
- Links to the identified new or emerging mHealth interventions in the appendices.

The appendices contain more detail about the identified emerging mHealth interventions, including information on the following areas (where available):

- Developer details.
- Platform e.g. Android or IOS.
- Description of the mHealth intervention including:
  - Application for public health topics of interest (e.g. positive mental health).
  - Behavioural change mechanism (e.g. coercion or skills and training).
  - Whether there is a requirement for health professional involvement in use.
- Further information including:
  - Costs.
  - Developmental phase.
  - Launch plans.
  - Regulatory issues.
  - Links to evidence.

4.4 MHEALTH INTERVENTION BY CATEGORY

4.4.1 TRACKERS

See Appendix 3 and Appendix 4 for new and emerging interventions identified.

Trackers monitor one or a number of key metrics. Trackers are available that encourage change in many areas of behaviour including positive mental health, healthy eating and increased physical activity.

Recently developed trackers contain software or links to companion apps and web portals that allow viewing and management of the data generated. This data can be used in a variety of ways, for example to personalise a weight loss program, set positive mental health goals or compete with friends on fitness challenges. In this way many trackers combine elements which encourage behavioural change alongside elements that monitor physical parameters.

Products can also contain possibilities for healthcare practitioner/patient partnerships in healthy behaviour plans with data from trackers feeding into mHealth platform systems (see 4.4.8 mHealth platforms).
Trackers can be active or passive, wearable or non-wearable, or a combination (Table 7).

**Table 7: Trackers by type**

<table>
<thead>
<tr>
<th>Active wearable</th>
<th>Passive wearable</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Headset which requires user input to provide details on type of exercise undertaken (tapping of buttons to record data.)</td>
<td>e.g. Wrist band that records physical activity patterns of user.</td>
</tr>
<tr>
<td><strong>Active non–wearable</strong></td>
<td><strong>Passive non–wearable</strong></td>
</tr>
<tr>
<td>e.g. Mood diary app that requires users to record details of their thoughts.</td>
<td>e.g. Non–contact sleep sensor.</td>
</tr>
</tbody>
</table>

Wearable and non–wearable trackers were the most commonly identified mHealth interventions in this review.

**4.4.1.1 Wearable trackers**

Wearable trackers usually include sensors as they can be incorporated into items of clothing or accessories which can be easily worn. These trackers can range from simple health tracking devices, such as pedometers, to sophisticated trackers that measure many physiological functions communicating with a smart phone, thus allowing the user access to their health information in real–time. The focus for many wearable trackers is the capture and use of health data relating to exercise and fitness levels (e.g. steps taken, heart and respiration rates) as well as sleep patterns (which can related to general wellness).

Wearable technology includes items such as jewellery, glasses, earphones and clothing as well as fitness bands, and other devices such as plaster like or tattoo stickers and implantable devices. Increasingly there is cross over with developers working on both smart watch and band products and other hybrid devices.

**Current examples include:**

- **Nike+ Fuelband SE** (US Developer) : A fitness band that uses gamification of fitness activities to turn all tracked movements into NikeFuel points which can unlock achievements, and allows engagement in competitions or sharing via social media.
- **RFID**: Existing technology such as RFID can be used for mHealth for example by implanting RFID chips in patients to track whereabouts.

The development of passive calorie tracking to support healthy eating has proved challenging for developers with a couple of companies identified having tried and not yet fully succeeded in the development of these types of trackers.
4.4.1.2 Non–wearable trackers

There is a wide range of non–wearable mobile–based trackers in the form of apps or other devices for exercise, healthy eating and positive mental health. However with the non–wearable trackers there is a greater evenness of coverage between those focused on exercise/diet and those focused on positive mental health.

Sometimes the device can be a unit that connects to an app, for example, a non–contact sleep monitoring device that captures sleep data and sends to a companion app. As with wearable trackers, products can contain additional features such as goal setting.

Current examples include:

Diet and exercise interventions:

- **MyFitnessPal** (USA): A standalone app that acts as a calorie tracker and also tracks exercise. The user enters data into the app\(^2\).

- **StepJockey** (UK): A calorie tracker app which is backed by the UK Department of Health. The app must be used in conjunction with StepJockey posters and smart signs. Once the smart signs are installed on stairs, they allow users to track stair climbs and calorie burn over time. Users scan/tap the StepJockey smart signs with the app at the start and finish of their climbs\(^3\).

Mental health interventions:

- **My Journey** (UK): An early intervention in psychosis, the My Journey app is designed to help track how users are feeling by working through a set of questions with an easy-to-use rating wheel. It can help users make informed choices about what to do to improve their mental health. As users work through the app, it also gives them simple tips on things they can do to help them feel better such as sleep, dietary and exercise advice\(^4\).

4.4.2 BRAIN TRAINING BIOFEEDBACK

See Appendix 5 for new and emerging interventions identified.

Biofeedback is the process of gaining greater awareness of many physiological functions with a goal of being able to manipulate them at will. These types of mHealth interventions have particular application for positive mental health by using concentration and relaxation techniques to control outcomes.

Current examples include:

- **Positive Technology** (EU): An app developed for the EU funded INTERSTRESS project that has developed a new approach in the treatment of psychological stress. The project introduced the concept of internality, which combines cognitive behavioural therapy with a hybrid, closed–loop empowering experience bridging real and virtual worlds. This model provides the opportunity for individual citizens to become active participants in their own health and well–being. The app aids relaxation through immersion in a mobile virtual scenario (a virtual island) featuring pre–recorded audio narratives guiding a series of relaxation techniques. During biofeedback
exercises, a wearable biosensor system provides data which directly modifies the virtual reality experience in real–time75.

- **Emotiv EPOC** (Australia): A headset which allows gamers to control a variety of software and games with the power of their mind. EEG headsets measure beta waves associated with human emotional response and concentration. Emotiv's Epoc is a wireless headset that uses 14 sensors to detect a player's brain activity, allowing them to communicate with their computer without touching a key76.

- **NeuroSky's Mindwave mobile** (US): A headset that uses a single electrode to measure attention and relaxation levels. This allows users to control games, use mental fitness apps and undertake relaxation exercises. NeuroSky offers a range of apps including Focus Pocus77 an adaptive game to improve mental wellbeing78.

Several third party developers have built on NeuroSky technology to create further mHealth interventions with around 400 research groups currently using NeuroSky headsets to explore potential for use in health79.

Some examples of third party development of NeuroSky technology include:

- **Myndplay Ltd.** (UK): uses NeuroSky chips inside its own headset to enable viewers to control the outcome of movie scenes by concentrating and relaxing to create short interactive films in which viewers step into the shoes of the protagonists and influence the plot by focusing or relaxing80.

- **MindReflector** (US): An app which uses the NeuroSky MindWave Headset to provide stress management training on themes of Quiet Focus, Meditative Relaxation, Full Spectrum Training, and Alpha/Theta Training81.

- **Chanter** (Netherlands): An app that uses NeuroSky MindWave Headset to provide a tool for people who would like to improve their meditation or mindfulness skills, which gives instant audio feedback about user’s state of meditation. The app plays a mantra–like audio loop, and changes the pitch of the loop according to the meditation level of the user82.

- **MindRDR** (UK): An app which aims to connect Google Glass and the NeuroSky MindWave headset. In doing this it allows users to take photos and share them on Twitter and Facebook using brainwaves alone. The app takes data from the EEG sensor and converts it to visual information via a white line overlaid onto imagery in the camera's viewfinder. In order to take a picture users have to concentrate until a horizontal line moves to the top of Glass' display. After the photo has been captured, users must concentrate to move the line to the top of the screen in order to share it. To discard the image and start again, users relax and the line will drop to the bottom of the display. MindRDR have made the code for the app open source with the hope that others may take this forward, adding functionality that will result in applications of benefit to public health or other health areas83.
4.4.3 SOCIAL INFLUENCE

See Appendix 6 for new and emerging interventions identified.

These mHealth interventions utilise influence and support from family, friends and healthcare providers to encourage behavioural change. The proliferation of social media and mobile phone usage has provided endless opportunities for linking with online support networks and this can be harnessed for healthcare purposes. It is possible to use mobile technologies to allow real-life support networks involving family and friends to help users achieve behavioural change.

Social influence mHealth interventions can address diet and exercise issues. However, they are particularly suitable for addressing mental health issues as they utilise existing support networks, which naturally cover mood and mental health support.

Social influence is included as an element in many of the other categories of interventions identified, for example wearable trackers. The interventions listed in this section use social influence as the primary agent for behavioural change.

4.4.4 COMPLIMENTARY INTERVENTIONS

See Appendix 7 for new and emerging interventions identified.

There are many mHealth interventions that work in conjunction with more traditional interventions to achieve behavioural change and reduction of risk factors. For example, a companion app or text service that can be used between sessions with the healthcare provider that forms part of the treatment. Again, this can be particularly useful in mental health services where the technology can be used in between face-to-face sessions with a mental health professional and provide crucial support and links between healthcare user and provider.

4.4.5 INTERNET OF HEALTHY THINGS

See Appendix 8 for new and emerging interventions identified.

The Internet of Things (IoT) is a proposed development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data. Following on from this, the “Internet of Healthy Things” has emerged as a sub–category of IoT. Many everyday items have been targets for development into connected products for encouraging healthy behaviours generally around the diet and exercise areas (e.g. smart bikes) usually with a Bluetooth linked companion app.

One trend has been to miniaturise and/or make mobile existing medical devices and technologies and then market them to the health “consumer”, rather than the healthcare provider.

Current examples include:

- **Beam Brush** (US): A connected toothbrush that communicates with smart phones to track brushing, compete with other brushers and earn rewards.

84
• **Withings Blood Pressure monitor** (France): A blood pressure monitor which allows users to measure and record blood pressure readings using a wireless cuff linked to a mobile phone.\(^6\)

### 4.4.6 ADHERENCE INTERVENTIONS

See **Appendix 9** for new and emerging interventions identified.

These are mHealth interventions that provide opportunities and incentives to stop unhealthy behaviours such as smoking and excessive drinking. These can work in a variety of ways and, as such, cross cut some of the other categories.

For instance these interventions can:

- Alert a user when they are in a location associated with increased risk of poor health behaviour, such as a favourite pub for someone with alcohol problems – so called “geofencing”. The mHealth interventions can then provide users with extra support at these points.
- Assist in behaviour change by using technology to make “Directly Observable Therapy” available remotely.
- Provide skills and training to support behaviour change.\(^a\)
- Track the effects of indulging in negative or positive health behaviours e.g. costs of smoking.\(^b\)
- Provide social support for those complying.\(^c\)

**Current examples include:**

**Smoking cessation interventions**

- **Moment Strong** (US): This app encourages users to comply with health and fitness goals. It is currently only available through workplace wellness programmes. The app uses geofencing techniques to send helpful messages to the user when they are in a specific location that user has previously designated as a place where they are likely to make a bad health decision.\(^6\)
- **Text2Quit** (US): An SMS smoking cessation program. The program offered participants outgoing messages about quitting smoking as well as help texts if they used allotted keywords to request the help.\(^7\)
- **SF-28** (UK): A mobile app to aid smoking cessation.\(^8\). A preliminary evaluation of this intervention has been published.\(^9\)
- **Mobile Commons** (US): An HIPAA compliant text messaging platform that has been in existence for several years and provides a suite of healthcare

---

\(^a\) Some adherence interventions may also be training interventions.

\(^b\) Some adherence interventions may also be trackers.

\(^c\) Some adherence interventions may also be social influence interventions.
solutions which can encourage behaviour change, or improve medication adherence.

- **Intelligent mobile support for therapy adherence and behaviour change** (Amsterdam): A computerized health behaviour intervention based on multiple psychological theories of behavioural change. The system determines the users’ reasons for non-adherence using a mobile phone app and an online lifestyle diary. The user then automatically receives generated messages with persuasive tailored content.

**Alcohol abstinence interventions**

- **SCRAM CAM™ Bracelet** (US): Continuous passive tracking allows a sweat sensor built into an ankle bracelet to detect alcohol in sweat levels. This can be used to ensure compliance in court order cases but has potential application for public health.

### 4.4.7 SKILLS TRAINING AND COACHING

See **Appendix 10** for new and emerging interventions identified.

There are many mHealth interventions that offer skills or training to improve health or wellbeing either through links to experts who provide skills, guidance and motivation or via training such as cognitive behavioural therapy. Skills training and coaching mHealth interventions can be found for diet, exercise and wellbeing.

**Current examples include:**

#### Exercise based interventions

- **Physical Therapy Pal** (US): The app allows a therapist to prescribe exercises for their patients and deliver interactive therapy exercise instructions. The app ensures that the exercises and instructions are not lost or thrown away. The system also gives visibility into patients' therapy compliance including when and where they may be struggling to perform their exercises away from the clinic. From the patient’s point of view the app helps them keep track of the exercises prescribed. The app also has video examples showing patients how to perform exercises and includes a feedback loop to communicate with the therapist.

- **TRIMM** (US): An automated 6–month text message research programme for weight loss undertaken under the Global mHealth Initiative programme at the Johns Hopkins University that offered personalised interactions that promoted accountability and self–monitoring. The programme ran from 2011–2013.

- **FitStar Personal Trainer** (US): A fitness app that offers either personalised yoga or fitness training which includes HD-quality videos, custom audio tracks and individual progress and milestones. Users can connect FitBit, Jawbone UP, or MyFitnessPal accounts to automatically sync their weight and fitness activity. There is also HealthKit integration and Apple TV support allowing users to view workouts on a bigger screen.
**Alcohol consumption reduction interventions**

- **Drink Coach** (UK): Available for use on Android and iPhone tablets and smartphones is a mixed functionality app to assist users in reduction of alcohol consumption. Available to the general public it contains a mix of tools to help reduce alcohol consumption including tracker, diary, mindfulness videos, time and location based reminders, goal setting and easy-to-read summaries. It has been reviewed and listed in best app lists by The Guardian, The Observer and the Sunday Times and listed in NHS App Library.

**Mental wellbeing interventions**

- **MoodHacker** (US): A CBT based app for mood management. A third release in Quarter 1, 2015 includes integration with the companies mobile health coaching app. It is currently deployed to employees in workplace wellness programmes. The app encourages self-management through a holistic approach including healthy habits around sleep, physical activity and nutrition.

### 4.4.8 MHEALTH PLATFORMS

See **Appendix 11** for new and emerging interventions identified.

Platforms are a way of aggregating data from various mHealth interventions and sharing that information between healthcare provider and healthcare users to improve health and wellbeing across the care pathway.

Many platforms combine a patient–facing engagement app with a clinician–facing dashboard for data access and two way messaging. In this way, developers argue, systems can save time and money for healthcare providers. The platform “dashboard” of patients will allow them to easily identify “problem” patients whom they can then target with direct messages. Platform systems can also be used to manage patients with co–morbidities to allow for a “whole person approach” rather than the patient having to deal with several different health care providers.

Platforms can also overlay with social networks so that users can “invite” friends/relatives/neighbours into their circle of care (remote monitoring) and may be customisable so that they can interface with existing systems. Some platforms are very much focused on wellness programmes and may be used by private companies with incentivisation for healthy behaviour choices. Other platforms may be more focused on disease management although they may also have application for wellness and prevention.

From the users’ point of view, the app element of the platform provides daily guidance and reminders including the possibility of personalised notes direct from the healthcare provider.

**Current examples include:**

- **Validic** (USA) : A digital health platform that covers wellness, prevention and disease management. Allows healthcare providers to access mobile and digital health data across fitness, clinical and other devices and platforms.
• **Florence** (UK): Primarily a text message based system. Clinical staff use Florence to collect readings or symptom information remotely from patients and in return the system sends health advice based on the readings as agreed with the clinical staff99.

• **Sens.ly** (USA): An avatar based platform. Patients can communicate their condition to an emotionally reactive avatar through their phone, desktop, or TV. The platform can be deployed across a number of areas including health behaviours100.

• **Virgin Pulse** (UK/Multinational developer): A wellness programme that combines social media, gamification, rewards, wearable fitness devices and mobile apps for employees to enable them to make healthy, long-lasting behaviour changes across all aspects of their lives. In early 2015, they partnered with third party providers to extend the programme to provide healthy eating tools101.

• **Hubbubhealth** (USA): A technology–driven wellness solution that uses social media and gamification to support employee wellbeing. The basic service is free to the public but employers can purchase additional features and upgrades102.

4.4.9 GAMING/OTHER ENTERTAINMENTS

See Appendix 12 for new and emerging interventions identified.

The gamification of health can occur in a variety of ways including mixing health and non-health messages, such as weather and sports in “health” apps, as well as the use of actual gaming apps. These apps may be used either in conjunction with wearable technology or as standalone entities. Many games incorporate training elements to improve health behaviours, whilst others provide incentives for health behaviours by linking health goals to unlocking the next stage of the game.

**Current examples include:**

**Exercise interventions**

• **Zombies, Run!** (UK): Players act a character through a series of missions, during which they listen to various audio narrations whilst running to uncover the story. The missions can only be completed if the players keep running103. An evaluation of this intervention is available104.

• **The Walk** (UK): Developed as part of the Technology Strategy Board’s (now Innovate UK) Small Business Research Initiative “The Walk” is an app that gamifies walking. Based on the Zombies, Run! Principle the app encourages players to walk 10,000 steps every day. The game features dynamic maps and a thriller storyline that players can only complete if they keep walking105.

**Mental wellbeing interventions**

• **The Voice in the Garden** (US): A narrative based game that uses players voice volume, intonation, and rhythm as the main input to unfold a narrative. The game is based on the voice therapy method of “Melodic Intonation Therapy” and translates the result to an interactive experience. The game
encourages players to read and sing. Player's input with voice and seeing direct visual feedback is helpful in integrating different sensory information. It has potential application for improved mental health through allowing players to recognize and further regain the power of their voice, and is also a potential tool for increasing positive feelings of self-worth.

- **Personal Zen** (US): This app embeds attention-bias medication training (ABMT) within a mobile gaming format. Built by a team of neuroscientists and mobile developers, Personal Zen is designed to retrain the brain to lower stress and anxiety. It works by getting players to shift their focus from a threatening stimulus, such as an angry face, to a non-threatening, happy face. In Personal Zen, happy-faced and angry-faced sprites pop up out of a grassy field. Players earn points by tracing a trail left by the happy-faced sprite as it burrows into the ground; thus they are directed away from the negative, threatening stimulus to instead focus on the happy face. The app has been the subject of a clinical trial.

### 4.5 QUESTIONNAIRE ANALYSIS: OPPORTUNITIES AND BARRIERS

The questionnaire sent to experts, developers and those with an interest in mHealth invited respondents to reflect on the future of mHealth. They were asked to identify potential issues for mHealth over the next 5 years with particular reference to public health.

#### 4.5.1 POTENTIAL BARRIERS

Potential barriers to the use of mHealth included:

- **The lack of an evidence base to support mHealth**

The evidence base for mHealth is not well developed as this is a new area for research.

**Selected questionnaire responses:**

- “The fast pace of technology makes full evaluation of apps as complex interventions (i.e. in randomised controlled trials) a particular challenge – and may mean we are not able to demonstrate whether or not they are effective.”

- “There is increasing evidence that most existing apps are based on little or no theory, or expert recommendations”

- “Few mHealth apps are rooted in the evidence-base for behaviour change”

- “Evidence – dearth of e–Health researchers in UK, with little recognition of it as a research discipline”
4.5.1.2 **NHS implementation**

Interventions developed in isolation from the context in which they are likely to be used may be difficult to integrate into the NHS.

**Selected questionnaire responses:**

- “The main problem with most of the technologies is that they are not sustainable (i.e. a waste of research and resources). Primary cause of this is that they fail to consider the overall environment of the patient and the patient’s circle of care.”

4.5.1.3 **Lack of engagement from users**

Some potential users may not be disposed towards using mHealth solutions. Older adults were perceived as being less likely to own the types of mobile devices that deliver many of the mHealth interventions presented or unable to use the devices. It was thought that other vulnerable groups may also be less able to access mHealth interventions due to issues such as cost, language barriers and learning disabilities. The long-term appeal to all users of mHealth solutions for wellness and prevention is considered unproven.

**Selected questionnaire responses:**

- “Risk that people often try apps but quickly lose interest – Uptake of apps when offered seem also to be low.”
- “Dexterity of older patients; need to include human contact, particularly in the older patient.”
- “Not everyone has a mobile – contracts can be very costly especially for using as 3G platform. Difficult for people who are not tech savvy – and these are potentially the people with the greatest health needs.”
- “Possible risk of exclusion for certain client groups e.g. learning disabilities, low income, homeless, non–English speaking.”

4.5.1.4 **Lack of engagement from healthcare providers**

Healthcare providers may not wish to engage with mHealth interventions. Reasons may include liability issues, distrust in the quality of interventions available for recommendation, cost, lack of knowledge, safety concerns or other personal preferences.

**Selected questionnaire responses:**

- “Professional preconceptions about the age or other characteristics of people who use mHealth can lead to under-referral and entrench health inequalities.”
- “One clinical app for morphine dosage was proven to give the wrong dose. If a clinician uses this and kills a patient, who is responsible? It's actually the clinician, but many may not know that.”
• “…health professionals struggle with the variable quality of services and may end up not referring any…”
• “Health boards (need) to embrace technology and use it to their advantage instead of steering away from it due to safety concerns.”

4.5.1.5 Lack of healthcare technology skills/literacy

Healthcare users and also potentially healthcare providers may lack the skills and knowledge to effectively use mHealth interventions.

Selected questionnaire responses:
• “Low health literacy (for most) Poor Digital literacy (for some)”
• “Lack of training and support for people using technology to improve health”

4.5.1.6 The quality (or lack) of the products on offer

There is an element of hype around many mHealth interventions which may disguise issues relating to product quality and usefulness. Users and providers of healthcare may need guidance to navigate their way to quality products.

Selected questionnaire responses:
• “A downside is ensuring the information provided through apps is quality assured. People receiving information that is not accurate could make incorrect choices regarding their health and social care. Also, this information should not overrule the information or advice given by professionals.”
• “Poor user interfaces”
• “Many are useless and some are positively harmful”
• “Need for fast track assessment /approvals process so that we can have a ‘bank’ of apps that people can trust”

4.5.1.7 Privacy and regulation

Users

and providers of healthcare will have concerns about data management in terms of privacy and liability respectively. Regulation can be seen as a barrier for developers.

Selected questionnaire responses:
• “Data privacy security and trust”
• “Regulatory hurdles”
• “need to ensure confidentiality and client choice are not compromised”
4.5.2 POTENTIAL OPPORTUNITIES

The most frequently cited opportunities were as follows:

4.5.2.1 Access

There are opportunities to reach a wide audience given the number of potential healthcare users with access to mobile technology.

Selected questionnaire responses:

- “Reaching clients in a very different medium & way. Opportunities for working with adolescents are particularly attractive”
- “Broadening access to key messages to those who may not otherwise be reached”
- “Mobile technologies are the fastest adopted technology of our species. The internet is pervasive and ubiquitous. These two factors collide to make the possibilities endless but also complex”
- “The instant access to mobile applications means that they can offer behaviour change interventions at point of need, which is a marked improvement on weekly, daily interventions that require anticipating need. This is one of the main reasons for the potential of mHealth solutions for improving wellness through diet, physical activity and mental health.”
- “Many opportunities as many people use and carry around smart devices everyday and for the most of the day so the potential for communication and interaction is high.”

4.5.2.2 Patient empowerment. e.g. co–managed care/personalised care

Patient choice and empowerment were frequently mentioned. Concepts such as “the quantified self” (self-monitoring), co-managing care and using mHealth interventions as an adjunct to NHS provision were highlighted.

Selected questionnaire responses:

- “I think the “quantified self is going to become more and more mainstream over the next five years with greater parts of the population (healthy or otherwise) self–monitoring. This will increase as technology becomes cheaper, more widely accessible and more intuitive.”
- “Will fill large gap for people who need support but do not feel ill enough to consult a healthcare professional. This is particularly important in the case of mental health which is stigmatised.”
- “There is considerable potential for co–management … between patients and clinicians.”
4.5.2.3 Ease pressures on other services

Issues around using mHealth interventions as an adjunct to NHS provision are seen as potentially helpful in reducing pressure on NHS services. This could be in terms of the prevention/maintaining wellness agenda or to relieve day-to-day pressure on areas such as mental health services.

Selected questionnaire responses:

- “Highly valuable for complementary therapy and non-judgemental, impartial, encouragement to promote healthy living.”
- “This would also help with the significant pressures being placed on NHS – we must do things differently and mHealth and mCare is the way forward.”
- “There are huge opportunities in mental health, where traditional services are currently struggling. One of the main things I see is a chance for tech based solutions to be offered while people are waiting for traditional face-to-face therapy.”
- “There is considerable potential for co-management… between service users and other professionals such as social workers or teachers.”

4.5.2.4 Developments in technology

The large amounts of data that can be generated by mHealth interventions has potential for use in research as well as disease management and prevention. mHealth technology also provides an opportunity to improve safety across all areas of health management.

Selected questionnaire responses:

- “Integration and linking of different data sets and personal data.”
- “For diet and wellness the obvious route is to open up the APIs from fitness trackers, smartwatches and phones into care plans, it won’t be clinically validated data but it doesn’t matter – it still provides a broad indicator if you’ve been active and eating healthily.”
- “Huge opportunities to passively collect data through mobile phones and use the data to support wellness and healthy behaviour change programmes using direct and personal messaging.”
- “Error trapping and idiot proofing is already commonplace in software design. The mHealth solutions themselves can actually improve safety over pen and paper and other solutions!”
This horizon scanning review identified a wide range of new and emerging mHealth interventions that could potentially be utilised in a public health programme to encourage behavioural change and achieve risk factor reduction in adults.

5.1 EMERGING MHEALTH INTERVENTIONS

At the time of conducting this horizon scanning review there was no standard categorisation for mHealth interventions. Several approaches could have been taken depending on stakeholder perspective. For example, categorising products according to risk is useful from a regulatory viewpoint, whilst from a technology approach there are distinct groupings of hardware and software such as sensors and application program types. For the purpose of this review interventions were categorised according to a mix of acknowledged concepts that could be useful when thinking about mHealth application in public health, with ten main categories utilised. As mHealth matures as a discipline it is possible that a more standardised approach to categorisation will emerge.

Hundreds of mHealth interventions were initially identified. Ninety four met the inclusion criteria and are described in the appendices. Trackers were the category of emerging mHealth interventions identified most frequently, with wearable trackers such as bands, watches and clothing being the most prolific (n=27), followed by non-wearables (n=12). Within wearable tracking interventions, there appears to be a trend for tracking devices to become more invisible. Smart clothing, contact lenses or tattoos/biostamps are less obvious than some of the fitness bands on the market, which can appear unattractive to some users and require frequent charging. In addition, more “invisible” devices can hold sensors closer to the skin thus potentially collecting more information and producing better data. Ultimately internally worn sensors such as those you swallow (ingestibles) or wear under the skin (implantables) may prove popular (Appendix 3: Table 2).

The next most common categories of emerging mHealth interventions identified were information/training/coaching interventions (n=10) and mHealth platforms (n=10). Information/training/coaching interventions represent a step-change from the more traditional provision of information by leaflets and videos, allowing immediate access to tailored information. Some of these interventions incorporate quick feedback on behaviour through either health professionals or social network support. mHealth platforms aim to offer a complete solution to allow both users and healthcare professionals to effectively co-manage the user’s health.

Across many types of mHealth interventions identified, social interaction elements were employed. These helped incentivise healthy behaviours by harnessing the power of social media to provide a way for users to stay in touch with existing social support networks wherever they are and using them to help achieve behavioural change through competition, coercion or modelling.

For mental wellbeing, emerging brain training biofeedback interventions were notable (n=6). They include a variety of hardware devices (headsets or handheld)
connected to apps which allow users to progress through scenarios or games by employing relaxation techniques acquired via biofeedback.

## 5.2 MHEALTH & PUBLIC HEALTH

Wellness and prevention are key targets for developers of mHealth interventions. Various aspects of Michie’s framework for characterising and designing behavioural change interventions were incorporated in the interventions we identified. Connecting with and sharing behaviour with friends and family or with like-minded strangers through apps and social networking sites allows an element of persuasion that until recently has been difficult to achieve. Incentivisation and coercion is potentially easy to achieve with many of the technologies providing instant feedback and rewards or penalties, some financial. In addition, innovative ways of increasing knowledge and skills through mHealth interventions may appeal to many of the general population including some hard to reach groups.

### 5.2.1 SHIFTING RESPONSIBILITY FOR HEALTH

Technological developments in mHealth have the potential for accelerating a cultural shift in thinking around health for individuals to take greater responsibility in their own health and wellness. In this way the focus for health could see a shift from treatment to prevention with users and healthcare providers working together to ensure best outcomes. For example, “internet of healthy things” data from wearables (e.g. smart watches), usables (e.g. smart bikes) and ingestibles (e.g. smart pills) – could all be used to alert users and providers alike to potential issues before symptoms appear.

Many of the technologies outlined in this review gather personal health data (PHD) from users. Such self–monitoring and self–sensing is often referred to as “lifelogging” and/or the “quantified self”. Advancements in technologies have allowed individuals to quantify all kinds of PHD from sleep to exercise and mood. One consequence of this is that individuals have a much higher level of self–knowledge than ever before and this may have unexpected consequences in terms of how individuals deal with this knowledge. It can be used to the good, in terms of helping users change unhealthy attitudes and behaviours, but it also has the potential to increase anxiety. How much knowledge is “enough” and how much is “too much” is likely to vary from individual to individual and for some the benefits of ignorance may outweigh those presented by the information generated.

### 5.2.2 INTEGRATION INTO EXISTING SYSTEMS

Whilst it is clear that many types of mHealth interventions are being developed that have potential for public health application, it is unclear how they will work alongside, or as an alternative to, existing interventions used in the NHS. Within this context, a successful mHealth intervention would need to be interoperable with other NHS systems and may need to seamlessly collect data from many different sources.

A number of approaches may be adopted:
• mHealth platforms are already being piloted within the NHS and it is likely that lessons learnt from early pilots of these systems will inform future implementation. Whilst the pilots identified focus primarily on issues such as disease management and medicine adherence there is potential for using mHealth platforms to manage population health.
• Initiatives that offer text support or app support as part of a complimentary intervention approach are also being used to assist with issues such as weight management, smoking cessation, diet, exercise and good mental health.
• mHealth interventions for mental wellbeing, such as apps that can be used whilst waiting to access mental health services, or to maintain good mental health between treatments, may provide a means of supplementing (resource poor) mental health service provision, but could also be promoted at a population level.
• mHealth trackers measuring sleep, weight, blood pressure and activity levels are being adopted by what has been termed as the “worried well”. These users will either self-manage outside of the NHS or bring their results to their GP.

5.2.3 PUBLIC HEALTH RESEARCH

In addition to the possibility of using mHealth solutions to improve population health there is a real opportunity to collect health data that can be used not only to improve the care of individuals but also to develop and target interventions, inform policy and direct further research. The work being done by Apple and Google in this area demonstrates the potential for using mHealth for recruiting people to clinical trials. Participants for research could be drawn from around the world as long as they have a smart phone and an internet connection.

5.3 IMPLEMENTATION AND ADOPTION

Many mHealth interventions are already being used by members of the public presumably with the self-motivated aim of monitoring and changing personal health-related behavior for the better. Formalising their use in a healthcare system will need the consideration of a number of areas to align them with other healthcare technologies.

5.3.1 INTEROPERABILITY

If implementation of mHealth interventions is to have an impact on health outcomes there is a need to ensure that the technologies involved can “talk” to each other so that the data being used is readily shared and available to relevant parties. They also need to be able to “talk” to other systems, such as NHS systems. Organisations already working in this area are taking this forward. The technological challenges to

\(^d\) Healthcare Information and Management Systems Society and Open mHealth.
be faced have been acknowledged by the NHS in a call for more interoperability between consumer health technology and NHS systems made by Public Health England’s Chief Innovation Officer, John Newton\textsuperscript{109}.

5.3.2 REGULATION

Whilst the FDA and the MRHA have gone some way to providing guidance about this market the regulatory environment is still grappling with the issues mHealth has presented. For example, when should a mHealth intervention be classified as a medical device? Many regulatory developments focus on apps and an approach based on pragmatism seems to be emerging with the general feeling that regulatory authorities are not wishing to become too burdensome to developers and so prove a barrier to innovation.

For those mHealth interventions deemed not to be medical devices, standards may be driven by initiatives such as the NHS Health Apps Library, the BSI best practise framework and the NIB apps assessment process currently under development. It is, however, hard to see how these initiatives can effectively manage the sheer volume of mHealth interventions (particularly apps) coming to market. The NIB forsees only 5 to 10 apps per year eventually obtaining an NHS “brand” from the estimated 10,000 apps considered at the beginning of the assessment process\textsuperscript{84}.

In addition, there is a lack of awareness and knowledge from some developers around regulatory issues. Many of the interventions identified for this review provided no information about the regulatory implications of their developments and what may be required. With the NHS being accustomed to a high level of regulation of medical technology this area may prove a major stumbling block.

5.3.3 EVIDENCE

Although there is some published and ongoing research looking at the safety, effectiveness and cost effectiveness of mHealth interventions, it is widely acknowledged that, whilst the evidence base is growing, it is not yet able to provide definitive justification for use of these technologies for behavioural change. Commissioners of services may be reluctant to commit resource to mHealth projects that are, as yet, unsupported by robust evidence and as a consequence this may act as a barrier to the adoption of mHealth within the NHS.

Due to the fast pace of the development of mHealth solutions and the long-term nature of what they are aiming to achieve, developing a sound evidence base will be a challenge. The timescale of introducing and an mHealth solution and then releasing a new version is much shorter than for designing, getting approval for, completing and publishing an RCT. Innovation in evaluation methods may be required to ensure that better use is made of the data that mHealth captures to build the mHealth evidence base more quickly. For example, by building randomised controlled trials into the mHealth interventions themselves.
5.4 BARRIERS TO ADOPTION

5.4.1 THE MHEALTH MARKET

Despite the proliferation of mHealth interventions, the market for them is fragmented, changeable and subject to hype. It is not uncommon for products to be advertised and then fail to either make it to production or to appear only briefly. This instability in the development pipeline could act as a barrier to adoption within the NHS.

Opinion is divided as to whether some mHealth interventions are here to stay or simply the latest trend, with a 2014 US survey suggesting that once the novelty wears off, people abandon their health wearable devices. Other barriers to consistent use of mHealth devices include the small/losable nature, lack of waterproofing, requirement to charge and physical appearance.

5.4.2 DATA ISSUES

The quality of patient-generated data is a concern. There is likely to be resistance from health professionals to accepting this as valid data and a cultural shift would need to occur for the majority of healthcare providers to accept data generated by unregulated technologies.

There is also concern regarding liability around the use and storage of patient generated data. Healthcare providers may not want to take ownership of patient generated data as it represents a risk which would expose them to liability should they fail to act on the data or store it securely.

Healthcare users may have privacy concerns, with the potential for patient generated data or PHD to feed into healthcare IT systems. Patient confidence may be low given that the NHS Health Apps Library failed to ensure that all the apps it recommended met quality standards in regard to the safety and security of personal data used. Even if patients have confidence in their immediate health care provider there is a risk that further organisations may ultimately exploit their data.

Insurance and employment companies have already begun to explore potential uses of PHD by developing mHealth wellness programmes that reward healthy behaviour with positive benefits, for example, lower insurance premiums or more days annual leave. However users may have concerns about any potential negative impact on premiums and employment.

5.4.3 MHEALTH LITERACY LEVELS

Managing personal health data is a skill that would need to be learnt and for many health services users this may prove a challenge. Whilst there is a requirement for users to have a certain level of “health literacy” developers need to consider language used, explanation of terms and the use of audio or video content to help get their messages across. In addition, healthcare users may need advice and
guidance on which tools to use and on how to assess their quality from the vast array of offerings in this area.

An editorial in the BMJ highlights some of the risks to healthcare users using mHealth interventions without sufficient knowledge or understanding either of the technologies or their suitability with regard to user needs:

“Patients may feel apprehensive or confused about the functions of these new instruments and may struggle with basic operations or in understanding the output that clinical technologies provide (such as graphs, summary scores). They may need help to translate the feedback they receive from a digital resource for follow-up action (for example, exercise, medication use, blood glucose monitoring, or self-management strategies). Without support, patients might misuse, underuse, or altogether disengage from potentially helpful clinical tools.”

The solution proposed in the editorial is the development of a new type of healthcare professional in the form of “clinical technology specialists” who would be familiar with the range of digital health resources, could assess patients’ interests, literacy, hearing, vision, dexterity, cognitive function, and preferences in order to match them with the tools most likely to work for them. Such specialists could provide an essential link between healthcare users and providers.

5.4.4 PERSONAL PREFERENCE

Many groups of users may not perceive a need for health apps and other mHealth interventions preferring more traditional forms of public health intervention and face-to-face contact with health professionals. Different population groups and individuals will have varying attitudes to using mHealth devices and sharing PHD via them. They will perceive the risks and benefits of doing so in different ways. “Always on” monitoring or mHealth device usage may simply be too intrusive or alien for some. However, for the so called “selfie generation” issues around personal data sharing and mobile device usage are likely to be viewed in a different light. Other factors that will determine attitude include the types of data being shared, for example, those with chronic or “embarrassing” conditions may not be willing to share PHD. In addition, difficult employment, financial or family situations or other cultural factors may influence preferences around this type of data sharing. Whatever the reason it will be important to avoid a health divide and offer healthcare users support or alternatives.

5.4.5 ACCESS

There is an assumption about the ubiquity of mobile technology devices in the general population. This needs to be balanced against considerations that smart phones and tablets are expensive - lack of access to these devices may be an issue for groups that may benefit the most from such public health interventions.
Horizon scanning across mHealth was challenging for several reasons. The sheer volume of technologies, especially apps, which are currently being developed or available means that identification of all emerging mHealth interventions, was neither practical nor achievable. Given this, approaches were devised that would provide a picture that would reflect the most interesting and innovative developments at this time. Expert opinion was obtained via an online questionnaire to highlight developments and developers. Some of the technologies and developers identified by experts were discovered to be outside the project scope on closer examination.

Given the infancy of the area and lack of definition around what may or may not be usefully considered a mHealth intervention this is, perhaps, unsurprising. This issue was mitigated however by further searches undertaken from a wide range of sources to provide a fuller picture of the technologies available.

Search terms used (including mHealth “mobile health” “mobile intervention*” “mobile comput*” app* SMS “Text messag*” Text–message*” Smart* Sensor) did not include specific terms relating to social influence technologies, although most social influence technologies of interest would also have been identified using the terms included.

The lack of established pipeline, range and volume of developments in this area will mean that some interesting developments are missed. In addition, the ability to identify technologies that may emerge in the longer term is limited. Most technologies included in the review had either recently become available in 2014/15 or were predicted to be available in 2015/16. For many technologies widespread diffusion and adoption will not occur given the experimental and disruptive phase of the market.
6. CONCLUSIONS

It is evident that mHealth is a rapidly evolving sector which presents challenges and opportunities for all stakeholders. The last eighteen months (2014/15) in particular have proved to be an important time for mobile and digital health. There are a proliferation of new and emerging mHealth interventions; many initiatives to encourage their development; and a number of policy documents and forward work programmes that are attempting to ensure mHealth is utilised for the benefit of the population.

Whilst individuals are using mHealth interventions outside of the NHS to obtain information about their health state more than ever before, it has yet to be seen as to whether this data is reliable and can be utilised to facilitate changes in health outcomes. Much scepticism remains as to the true value and quality of these interventions and further development of the evidence base may be required before there is widespread use.

Target users of mHealth interventions are a heterogeneous group with differing needs and preferences. For each technologically literate “worried well” there are individuals who may not wish to, or be able to, engage with mHealth technology or who may have particular concerns about certain aspects such as data privacy. A “one size fits all” approach to mHealth is unlikely to succeed and public health programmes will need to learn when mHealth interventions are useful, when they are not and how they complement existing systems.

The NHS and associated public health programmes can choose to take any or a combination of the following stances:

- Not directly engage with mHealth interventions given the complexity of the market. Whilst this approach may simplify matters in the short term it may also result in users going elsewhere to manage their health. A segmented service where users dip in and out of NHS services may develop. This may have advantages for individuals wishing to take ownership of their own wellness. It may also help users having difficulty accessing some health services by supplementing NHS provision. However, there is a risk that a two-tier system may emerge with the mHealth and technologically literate “worried well” gaining all the advantages offered whilst more vulnerable groups are left behind. Health professionals may also be expected to act upon patient generated data of undetermined quality.

- Act to signpost high quality mHealth interventions and support users. Initiatives such as the NHS Health Apps Library and the National Information Board’s app assessment framework could fulfil this role but the challenges presented are considerable given the numbers of mHealth interventions coming to market. Such initiatives may be joined by other evaluative, quality assessment resources alongside more formal regulatory approval where appropriate.

- A stance of active watchfulness may be appropriate given that the market needs to settle and standards and evidence have yet to emerge. Commissioners and providers of healthcare may accept that the evidence base and standards are likely to develop in tandem with implementation of
mHealth interventions. The NHS and public health programmes can and are starting to experiment with small scale deployments with some mHealth interventions containing an embedded trial element which contribute to the evidence building process. Seeking exposure to mHealth interventions in this way compliments the fast pace of mHealth development cycle timescales.

- Finally, there is a continuing role for funders of research to support innovation and to assist in bringing stable, well developed products to market.

Whilst it is clear that there are considerable challenges to be overcome to deploy mHealth within or alongside existing public health programmes, to fail to consider its potential for public health and beyond would be a missed opportunity to improve both individuals’ health and healthcare systems.
App: An applications program, in this context a computer program, designed to carry out a specific task or meet a specific user requirement. Mobile apps are designed to run on mobile devices such as smart phones and tablets.

Big data: Big data is a broad term for data sets so large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, searching, sharing, storage, transfer, visualization, and information privacy.

Digital behavioural change interventions: Interactive, automated packages of advice and ongoing support for behaviour change, providing personalised advice based on the user’s needs, situation and preferences, support for goal-setting, planning and progress monitoring, automated reminders and progress-relevant feedback and encouragement and access to social support by email and online forums113. These may or may not be mHealth based technologies.

Internet of Healthy Things: A subset of the Internet of Things with a healthcare focus.

Internet of Things: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

Mindfulness: The state of being both fully aware of the moment and of being self-conscious of and attentive to this awareness; a state of intense concentration on one’s own thought processes; self-awareness. The term is often diluted from it’s origins to now encompass a range of meditation techniques, treatments for daily stress, even ways to lose weight.

mHealth: The use of mobile technologies to deliver healthcare solutions. These technologies could include mobile phones, patient monitoring devices, tablets, wearable technology, sensors, other wireless devices as well as software (including apps). mHealth is a relatively new concept and definitions vary1.

Personalised care: Bespoke care whereby the clinician and patient agree on care plans and targets and set goals.

Personal health data: Identifiable data relating to an individual’s health.

Operating system: Also referred to as platforms (as in mobile phone platforms Android or iOS). Describes the low-level software that supports a computer’s basic functions, such as scheduling tasks and controlling peripherals.

SMS: Short Messaging Service is a text messaging service component of phone, Web, or mobile communication systems. It uses standardized communications protocols to allow fixed line or mobile phone devices to exchange short text messages.
**Social Media:** A group of Internet-based applications that build on the ideological and technological foundations of Web2.0 and that allow the creation and exchange of user generated content. Social media technologies may include internet fora, blogs, microblogs, collaborative projects, social gaming element, social bookmarking, social networks and image broadcasting. Examples of social media include Facebook, Twitter, YouTube, Flickr and Google+.

**Wearable tracker:** A wearable device that can detect some activity, sleep or other patterns through inbuilt sensors which wirelessly interact with an app in a mobile device that configures and displays the wearer's activity data.
In addition to a general Google search, the following sources were searched between October 2014 and May 2015 to identify mHealth solutions:

<table>
<thead>
<tr>
<th>Source of intelligence</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mHealth project repositories</strong></td>
<td></td>
</tr>
<tr>
<td>GSMA mHealth Tracker</td>
<td><a href="http://www.gsma.com/mobilefordevelopment/programmes/mhealth/mhealth-deployment-tracker">http://www.gsma.com/mobilefordevelopment/programmes/mhealth/mhealth-deployment-tracker</a></td>
</tr>
<tr>
<td>mHealth Working Group Inventory of Projects</td>
<td><a href="https://www.mhealthworkinggroup.org/projects/mhealth-working-group-inventory-projects">https://www.mhealthworkinggroup.org/projects/mhealth-working-group-inventory-projects</a></td>
</tr>
<tr>
<td><strong>Alerts subscribed to:</strong></td>
<td></td>
</tr>
<tr>
<td>Medical futurist</td>
<td><a href="http://themedicalfuturist.com/">http://themedicalfuturist.com/</a></td>
</tr>
<tr>
<td>MobiHealthNews</td>
<td><a href="http://mobihealthnews.com/">http://mobihealthnews.com/</a></td>
</tr>
<tr>
<td>MedCity News</td>
<td><a href="http://medcitynews.com/">http://medcitynews.com/</a></td>
</tr>
<tr>
<td>mHealth Spot</td>
<td><a href="http://mhealthspot.com/">http://mhealthspot.com/</a></td>
</tr>
<tr>
<td>mHealth working group discussion lists</td>
<td><a href="https://www.mhealthworkinggroup.org/">https://www.mhealthworkinggroup.org/</a></td>
</tr>
<tr>
<td><strong>Funders of research</strong></td>
<td></td>
</tr>
<tr>
<td>NESTA</td>
<td><a href="http://www.nesta.org.uk/">http://www.nesta.org.uk/</a></td>
</tr>
<tr>
<td>Innovate UK (Health tech SIG)</td>
<td><a href="https://connect.innovateuk.org/web/digital-health/articles">https://connect.innovateuk.org/web/digital-health/articles</a></td>
</tr>
<tr>
<td>EPSRC</td>
<td><a href="https://www.epsrc.ac.uk/">https://www.epsrc.ac.uk/</a></td>
</tr>
<tr>
<td>Research Councils UK</td>
<td><a href="http://gtr.rcuk.ac.uk/">http://gtr.rcuk.ac.uk/</a></td>
</tr>
<tr>
<td>European Commission</td>
<td><a href="http://ec.europa.eu/index_en.htm">http://ec.europa.eu/index_en.htm</a></td>
</tr>
<tr>
<td>NIHR (including i4i)</td>
<td><a href="http://www.nihr.ac.uk/">http://www.nihr.ac.uk/</a></td>
</tr>
<tr>
<td><strong>Horizon scanning databases and NIHR HSC sources</strong></td>
<td></td>
</tr>
<tr>
<td>AHRQ</td>
<td><a href="http://www.ahrq.gov/">http://www.ahrq.gov/</a></td>
</tr>
<tr>
<td>Euroscan</td>
<td><a href="http://euroscan.org/">http://euroscan.org/</a></td>
</tr>
<tr>
<td>CADTH</td>
<td><a href="https://www.cadth.ca/">https://www.cadth.ca/</a></td>
</tr>
<tr>
<td><strong>Organisational websites</strong></td>
<td></td>
</tr>
<tr>
<td>mHealth alliance</td>
<td><a href="http://www.mhealthknowledge.org/">http://www.mhealthknowledge.org/</a></td>
</tr>
<tr>
<td>Digital health coalition</td>
<td><a href="http://digitalhealthcoalition.org/">http://digitalhealthcoalition.org/</a></td>
</tr>
<tr>
<td>HRSA’s office for the advancement of telehealth</td>
<td><a href="http://www.hrsa.gov/ruralhealth/about/telehealth/">http://www.hrsa.gov/ruralhealth/about/telehealth/</a></td>
</tr>
<tr>
<td>American Telemedicine Association</td>
<td><a href="http://www.americantelemed.org/">http://www.americantelemed.org/</a></td>
</tr>
<tr>
<td>National Telehealth Resources Centres</td>
<td><a href="http://www.telehealthresourcecenter.org/">http://www.telehealthresourcecenter.org/</a></td>
</tr>
<tr>
<td>HIMSS – Healthcare Information and</td>
<td><a href="http://www.himss.org/">http://www.himss.org/</a></td>
</tr>
<tr>
<td>Management Systems Society</td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>Telecare Services Association</td>
<td><a href="http://www.telecare.org.uk/">http://www.telecare.org.uk/</a></td>
</tr>
</tbody>
</table>

### Journals

<table>
<thead>
<tr>
<th>American Behavioural Scientist</th>
<th><a href="http://abs.sagepub.com/">http://abs.sagepub.com/</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour Modification</td>
<td><a href="http://bmo.sagepub.com/">http://bmo.sagepub.com/</a></td>
</tr>
<tr>
<td>Behaviour and Cognitive Neuroscience reviews</td>
<td><a href="http://bcn.sagepub.com/">http://bcn.sagepub.com/</a></td>
</tr>
<tr>
<td>Big Data and Society</td>
<td><a href="http://bds.sagepub.com/">http://bds.sagepub.com/</a></td>
</tr>
<tr>
<td>Bulletin of Science Technology &amp; Society</td>
<td><a href="http://bst.sagepub.com/">http://bst.sagepub.com/</a></td>
</tr>
<tr>
<td>Health Informatics Journal</td>
<td><a href="http://jhi.sagepub.com/">http://jhi.sagepub.com/</a></td>
</tr>
<tr>
<td>InnovAiT: Education and inspiration for general practice</td>
<td><a href="http://ino.sagepub.com/">http://ino.sagepub.com/</a></td>
</tr>
<tr>
<td>Journal for Health and Social Behaviour</td>
<td><a href="http://hsb.sagepub.com/">http://hsb.sagepub.com/</a></td>
</tr>
<tr>
<td>Journal for Health Psychology</td>
<td><a href="http://hpq.sagepub.com/">http://hpq.sagepub.com/</a></td>
</tr>
<tr>
<td>Journal of Information Science</td>
<td><a href="http://jis.sagepub.com/">http://jis.sagepub.com/</a></td>
</tr>
<tr>
<td>Perspectives in Public Health</td>
<td><a href="http://rsh.sagepub.com/">http://rsh.sagepub.com/</a></td>
</tr>
<tr>
<td>Telemedicine and EHealth</td>
<td><a href="http://jtt.sagepub.com/">http://jtt.sagepub.com/</a></td>
</tr>
<tr>
<td>Journal of Telemedicine and Telecare</td>
<td><a href="http://jtt.sagepub.com/">http://jtt.sagepub.com/</a></td>
</tr>
<tr>
<td>Journal of Biomedical Informatics</td>
<td><a href="http://www.journals.elsevier.com/journal-of-biomedical-informatics/">http://www.journals.elsevier.com/journal-of-biomedical-informatics/</a></td>
</tr>
<tr>
<td>Internet Interventions</td>
<td><a href="http://www.journals.elsevier.com/internet-interventions/">http://www.journals.elsevier.com/internet-interventions/</a></td>
</tr>
<tr>
<td>Journal of Medical Internet research</td>
<td><a href="http://www.jmir.org/">http://www.jmir.org/</a></td>
</tr>
<tr>
<td>Journal for mHealth and UHealth</td>
<td><a href="http://mhealth.jmir.org/">http://mhealth.jmir.org/</a></td>
</tr>
<tr>
<td>Journal of the International Society for Telemedicine and eHealth</td>
<td><a href="http://journals.ukzn.ac.za/index.php/JISfTeH/index">http://journals.ukzn.ac.za/index.php/JISfTeH/index</a></td>
</tr>
</tbody>
</table>

### Twitter accounts followed and searched for mHealth terms.

- Talk health research @NIHR_CCF
- CLAHRC East Midlands @CLAHRC_EM
- Peter Gregson @petergregson
- Race Yourself @Race_Yourself
- Markoneinfour @MarkOneinFour
- Med-Tech Innovation @medtechonline
- Hexoskin France @HexoskinFrance
- Paul Sonnier @Paul_Sonnier
- NLGN @NLGNthinktank
- NIHR MindTech @NIHR_MindTech
- Nesta, UK @nesta_uk
- Innovation_Unit @Innovation_Unit
- Maneesh Juneja @ManeeshJuneja
- Cisco UK & Ireland @CiscoUKI
<table>
<thead>
<tr>
<th>HealthIT &amp; mHealth @HealthITmHealth</th>
<th>DigitalHealthCo @digitalhealthco</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHealth @MobileHealthRR</td>
<td>mHealth WG @mHealthWG</td>
</tr>
<tr>
<td>David Doughty @SusHealth_Chair</td>
<td>Adam Landman @landmaad</td>
</tr>
<tr>
<td>Bruce Keogh @DrBruceKeogh</td>
<td>Michael Seres @mjseres</td>
</tr>
<tr>
<td>buddhify @buddhify</td>
<td>Kathryn Grace @wecaredesign</td>
</tr>
<tr>
<td>Rohan Gunatillake @rohan_21awake</td>
<td>Bakul Patel @bakulpatel</td>
</tr>
<tr>
<td>Graham Boulton @FocusBand</td>
<td>Sarah Amani @S_Amani</td>
</tr>
<tr>
<td>CATCH @CATCH_UOS</td>
<td>InnovationLabs @InnovLabs</td>
</tr>
<tr>
<td>Buddy @BuddyappUK</td>
<td>ben goldacre @bengoldacre</td>
</tr>
<tr>
<td>Peter Rubin @provenself</td>
<td>American Telemed @AmericanTelemed</td>
</tr>
<tr>
<td>Bristol Health @BristolHealthPartn</td>
<td>NEC Healthcare @NECHcare</td>
</tr>
<tr>
<td>FierceMedicalDevices @FierceMedDev</td>
<td>Julia Clarke @JuliaClarke_BCH</td>
</tr>
<tr>
<td>King’sHealthPartners @kingshealth</td>
<td>Time to Change @TimetoChange</td>
</tr>
<tr>
<td>The Long + Short @longshortmag</td>
<td>RC of Psychiatrists @rcpsych</td>
</tr>
<tr>
<td>ICHP @Ldn_ICHP</td>
<td>Salford R+D @SalfordRD</td>
</tr>
<tr>
<td>mHealth Spot @mHealthSpot</td>
<td>CLAHRRC GM @CLAHRRC_GM</td>
</tr>
<tr>
<td>mHealth Technologies @mHealthTechnology</td>
<td>CLAHRRC West Midlands @CLAHRRC_WM</td>
</tr>
<tr>
<td>2020health @2020health</td>
<td>Imperial Spark @ImperialSpark</td>
</tr>
<tr>
<td>Jessica Bland @pesska</td>
<td>ImperialGlobalHealth @ImperialIGHI</td>
</tr>
<tr>
<td>WHO @WHO</td>
<td>CLAHRRC NWL @CLAHRRC_NWL</td>
</tr>
<tr>
<td>CellScope, Inc. @CellScope</td>
<td>ImperialCollegeAHSC @ImperialAHSC</td>
</tr>
<tr>
<td>ABHI @UK_ABHI</td>
<td>UCLPartners @UCLPartners</td>
</tr>
<tr>
<td>AiCure @AiCureMed</td>
<td>Michelle Rogers @HF_HITLab</td>
</tr>
<tr>
<td>mHealthWatch @mHealthW</td>
<td>Edward Green @edwardgreen94</td>
</tr>
<tr>
<td>TRUSTECH @TRUSTECH_NHS</td>
<td>eHealthWeek15 @eHealthWeekEU</td>
</tr>
<tr>
<td>NHS European Office @NHSCConfed_EU</td>
<td>Mike Clark @clarkmike</td>
</tr>
<tr>
<td>DigitalHealthSummit @dhsummit</td>
<td>eB2B_Health @eB2B_Health</td>
</tr>
<tr>
<td>ProteusDigitalHealth @ProteusDH</td>
<td>Digital Catapult @DigiCatapult</td>
</tr>
<tr>
<td>ActiveHealthyAgeing @EIP_AHA</td>
<td>FierceHealthIT @FierceHealthIT</td>
</tr>
<tr>
<td>Revvo @GoRevvo</td>
<td>HIMSS @HIMSS</td>
</tr>
<tr>
<td>Get On Up @getonupapp</td>
<td>MICH @UM_MICH @CQC @CareQualityComm</td>
</tr>
<tr>
<td>Innovate UK @innovate_uk</td>
<td>NHS England @NHSEngland</td>
</tr>
<tr>
<td>Telemedicine Journal @Telemedicine_Jn</td>
<td>HealthServiceJournal @HSSJnews</td>
</tr>
<tr>
<td>telecareaware @telecareaware</td>
<td>Berci Meskő, MD, PhD @Berci Health 2.0 @health2con</td>
</tr>
<tr>
<td>HEALTHCARE IS MOBILE @MhealthForAll</td>
<td>NHS Confederation @nhsconfed</td>
</tr>
<tr>
<td>Open mHealth @OpenmHealth</td>
<td>iMedicalApps.com @iMedicalApps</td>
</tr>
<tr>
<td>mHealth Fans @mHealthFans</td>
<td>Health 2.0 Europe @Health2eu</td>
</tr>
<tr>
<td>mHealth News @mhealth_news</td>
<td>Department of Health @DHgovuk</td>
</tr>
<tr>
<td>mHealth Insight @mhealth</td>
<td>DigitalLifeSciences @DigiLifeSci</td>
</tr>
<tr>
<td>NHSInnovationsNorth @nhsinnovations</td>
<td></td>
</tr>
<tr>
<td>CentreForTelehealth @TelehealthHull</td>
<td>Health2.0 Birmingham @Health2Brum</td>
</tr>
<tr>
<td>Zahid Latif @zahid_latif_uk</td>
<td>The King's Fund @TheKingsFund</td>
</tr>
<tr>
<td>HealthEnterpriseEast @HealthEnterpris</td>
<td>@BVHC_ @ViH_Forum</td>
</tr>
<tr>
<td>NHSN @The_NHSN</td>
<td>EMAHSN @EM_AHSN</td>
</tr>
<tr>
<td>SEHTA UK @SEHTA_UK</td>
<td>AHSN Yorks &amp; Humber @AHSN_YandH</td>
</tr>
<tr>
<td>SBRI Healthcare @sbrihealthcare</td>
<td>GM AHSN @GM_AHSN</td>
</tr>
<tr>
<td>NIH Research @OfficialNIHR</td>
<td>ECHAlliance @ECHAlliance</td>
</tr>
<tr>
<td>KSS AHSN @KSSAHSN</td>
<td>HeRC @HeRCNorth</td>
</tr>
<tr>
<td>Wessex AHSN @WessexAHSN</td>
<td>MobiHealthNews @MobiHealthNews</td>
</tr>
<tr>
<td>ADI_Health @ADI_Health</td>
<td>WMAHSN @wmahsn</td>
</tr>
<tr>
<td>LivingLifetoTheFull @LLTTFNEWS</td>
<td>WMHINet @WMHINet</td>
</tr>
<tr>
<td>Kumar Jacob @kumarKJx</td>
<td>Digital Agenda @DigitalAgendaEU</td>
</tr>
<tr>
<td>Oxford AHSN @OxfordAHSN</td>
<td>FastForward Health @fastfwdhealth</td>
</tr>
<tr>
<td>AHSN NENC @AHSN_NENC</td>
<td>FirstApp @FirstApp_</td>
</tr>
<tr>
<td>NWC AHSN @NWCAHSN</td>
<td>UCL Digital Health @UCL_FDH</td>
</tr>
<tr>
<td>JHU Global mHealth @JHUmHealth</td>
<td>Digital Healthcare @IDHwarwick</td>
</tr>
<tr>
<td>SocialWeltth @SocialWeltth</td>
<td>Innovation HealthJam @InnovHealthJam</td>
</tr>
<tr>
<td>BBC Technology @BBCTech</td>
<td>Kathryn Grace @IamKathrynGrace</td>
</tr>
<tr>
<td>WIRED @WIRED</td>
<td>Victoria Betton @VictoriaBetton</td>
</tr>
<tr>
<td>HSCIC @hscic</td>
<td>mHealthHabitat @mHealthHabitat</td>
</tr>
<tr>
<td>Medivizor @medivizor</td>
<td>NIHR HSC @OfficialNHSC</td>
</tr>
<tr>
<td>TechCrunch @TechCrunch</td>
<td>NEHTA eHealth @eHealthAus</td>
</tr>
<tr>
<td>eHealth Initiative @eHealthDC</td>
<td>EU_eHealth @EU_eHealth</td>
</tr>
<tr>
<td>EHealth Insider @EHealthInsider</td>
<td>DigitalStitch @digitalstitched</td>
</tr>
<tr>
<td>Salus Digital @SalusDigital</td>
<td>Ctr Connected Health @connectededhealth</td>
</tr>
<tr>
<td>UCL Advances @UCLAAdvances</td>
<td>Healthcare IT News @HITNewsTweet</td>
</tr>
<tr>
<td>DigitalBusinessLabs @UCL_DBL</td>
<td>FierceHealth @FierceHealth</td>
</tr>
<tr>
<td>IDEA London @IDEALondon</td>
<td>iHealthBeat.org @iHealthBeat</td>
</tr>
<tr>
<td>Will Pearson @sacculi</td>
<td>mHealth Insight @mHealthInsight</td>
</tr>
<tr>
<td>TED Talks @TEDTalks</td>
<td>Alison Longwill @woodcotealison</td>
</tr>
<tr>
<td>Brian Dolan @mobilehealth</td>
<td>MedCrunch @medcrunch</td>
</tr>
<tr>
<td>NEF @NEF</td>
<td>mHealth Summit @mhealthsummit</td>
</tr>
</tbody>
</table>

| Search terms |
| Prevenion terms | Exercise, Physical Activity, Diet, “Healthy Eating”, “Mental Health”, Wellbeing, Smoking, Obesity |
The following sources were used between to identify potential mHealth experts to participate in the review.

<table>
<thead>
<tr>
<th>Expert identification sources</th>
<th>mHealth Networks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>• mHealth Habitat Leeds</td>
<td></td>
</tr>
<tr>
<td>• mHealth working group</td>
<td></td>
</tr>
<tr>
<td>• mHealth Alliance</td>
<td></td>
</tr>
<tr>
<td>• European mHealth Alliance (EuMHA)</td>
<td></td>
</tr>
<tr>
<td>• Digital Health Coalition</td>
<td></td>
</tr>
<tr>
<td>• MindTech team</td>
<td></td>
</tr>
<tr>
<td>• UCL partners</td>
<td></td>
</tr>
<tr>
<td>• Digital Economy Catapult</td>
<td></td>
</tr>
<tr>
<td>• HANDI</td>
<td></td>
</tr>
<tr>
<td>• Health Tech and Medicines KTN</td>
<td></td>
</tr>
<tr>
<td>• West Midlands Health Informatics Network</td>
<td></td>
</tr>
<tr>
<td>• CHAIN (generalist research network)</td>
<td></td>
</tr>
<tr>
<td>• European Connected Health Alliance</td>
<td></td>
</tr>
<tr>
<td>• mHealth topic discussion group on Linked-in</td>
<td></td>
</tr>
<tr>
<td>• WHO mHealth technical advisory group</td>
<td></td>
</tr>
</tbody>
</table>

**Academic Health Science Networks** - with an interest in digital health and/or public health

- Oxford AHSN
- Wessex AHSN
- West Midlands AHSN
- East Midlands AHSN
- Yorkshire and Humber AHSN

**Collaborations for Leadership in Applied Health Research and Care (CLAHRCs)** - with an interest in digital health and/or public health

- North Thames CLAHRC
- Yorkshire and Humber CLAHRC
- Oxford CLAHRC
- North West London CLAHRC

**National Virtual Incubator Networks**

- Idea Scotland
- University of Strathclyde Glasgow
- Sunderland Software City
- Manchester Science Parks
- The Landing at Media City
- Idea London
- Innovation Birmingham
- Coventry University Enterprise
- ehi Swansea
- JANET
- Cambridge Judge Business School
- Digital Enterprise Greenwich
Conference listings (Applying limits including: Non–commercial/public health or behavioural change focus/ Patient perspective included/European/US/Australia)

- mHealth summit 2014
- mHealth summit Europe 2014
- Mobile Healthcare 2014
- Royal Society of Medicine conference on medical apps 2014
- Speakers listed in the “Health apps: where do they make sense White Paper” (UK)
  Based on a seminar held at the Kings Fund, London, 28/10/13.
- Disruptive Innovation in Clinical Trials, London, 4-5/3/14
- Mobile Health Strategies for Lifescience, Philadelphia, USA, 12/3/14
- EyeforPharma Summit, Barcelona, Spain, 18-20/3/14
- Health2.0 Manchester: Regulatory requirements for mHealth apps, Manchester, 27/3/14
- mHealth Symposium at World of Health IT, Nice, France, 2/4/14
- mHealth – Enhancing Cancer Support Care, Milan, Italy, 4/4/14
- Health on the Go: the Law and Business of mHealth, Philadelphia, USA, 4/4/14
- mHealth for maternal health: bridging the gaps, Boston, USA, 7-8/4/14
- Med-e-Tel, Luxembourg, Brussels, 9-11/4/14
- TEDMED, Washington DC, USA, 9-11/4/14
- mHealth Habitat NHS Hack Day, Leeds, 11/4/14
- Imagining the Future of Medicine, London, 21/4/14
- Health2.0Boston: How Helpful Are Mobile Healthcare Apps?, Boston, USA, 24/4/14
- Apps for Health, Ontario, Canada, 25/4/14
- mHealth Hype or Hope, London, 29/4/14
- Canadian Advanced Technology Alliance: Mobile Health Roundtable, Ottawa, Canada, 29/4/14
- mHealth Habitat Show and Tell, Leeds, 14/5/14
- Mobile Health Technology Innovations – Ubiquitous Monitoring Future, Santa Clara, USA, 15/5/14
- ATA 2014, Baltimore, USA, 17-20/5/14
- mHealth Summit Asia Pacific, Sydney, Australia, 20-21/5/14
- mHealth Summit Middle East, Abu Dhabi, UAE, 28-29th/5/14
- Digital Health Forum, London, 24/6/14
- RCPsych International Congress, London, 24-26/6/14
- Health2.0London: Mobile Health, is it a reality or still hype?, London, 16/7/14
- mHealth + Telehealth World, Boston, USA, 23-25/7/14
- mHealth Israel, Tel Aviv, Israel, 10/9/14
- EyeforPharma Value Added Services & Multichannel Marketing Summit, London, 17-18/9/14
- MOBIHEALTH 2014, Athens, Greece, 3-5/11/14
- HISI Conference 2014, Dublin Castle, Ireland, 19-20/11/14

Not for profit organisations

- Patient View
- Lawford Davies Denoon
- Mindapps.org
- Digital Health Institute
- Royal Society of Medicine
- Bristol Community Health
- South Staffordshire and Shropshire Healthcare
- Center for Injury Research and Prevention, The children's hospital of Philadelphia
- International Society for Telemedicine and eHealth
- American Telemedicine Association
- Surrey and Borders Partnership NHS Foundation Trust
- Royal College of General Practitioners
- Diabetes UK

### UK academic institutes in following subject areas: Biomedical Engineering, Health Informatics, Behavioural Psychology and Public Health

- School of Nursing and Midwifery (Plymouth University)
- Institute of Digital Health (University of Warwick)
- Centre for Health Services Research (City University London)
- Research Department of Primary Care and Population Health and Centre for Behavioural Change (University College London)
- Global eHealth Unit, Department of Primary Care and Public Health (Imperial College London)
- Yorkshire Centre for Health Informatics, (University of Leeds)
- St Helens and Knowsley NHS Trust and Liverpool University
- Centre for Usable Home Technology (Newcastle University and CUHTec)
- School of Clinical Medicine (University of Cambridge)
- Institute of Public Health (University of Cambridge)
- Institute of health and psychology (Newcastle University)
- School of Health and Related Research (University of Sheffield)
- Institute of Biomedical Engineering (Oxford University)
- Dept of Bioengineering (Imperial College London)
- Dept of Biomedical Engineering (Kings College London)
- Division of Biomedical Engineering (University of Glasgow)
- Department of Biomedical engineering (University of Strathclyde)
- Department is of Electronic, Electrical and Biomedical Engineering (City University of London)
- Institute of Biomedical Engineering (University College London)
- Institute of Medical Engineering and Medical Physics (Cardiff University)
- Institute of Medical and Biological Engineering (Leeds University)
- Cambridge Institute of Public Health
- Institute for Primary Care and Public Health (Cardiff University)
- Institute of Health and wellbeing (University of Glasgow)
- Institute of Psychology Health and Wellbeing (University of Liverpool)
- Institute of Health and Society (University of Newcastle)
- Centre for Health Informatics & Multiprofessional Education (UCL)
- Centre for Health Informatics (University of Manchester)
- Yorkshire Centre for Health Informatics (University of Leeds)
- Health E-research Centre (FARR institute hub)
- Centre for Healthcare Modelling and Informatics (University of Portsmouth)
- eHealth and Informatics Research at (Swansea University)
- The Sowerby Centre for Health Informatics at Newcastle
- Institute of Psychological Sciences (University of Leeds)
- School of Psychology (University of Birmingham)
### Table 1: Connected bands, bracelets and watches

<table>
<thead>
<tr>
<th>mHealth technology and developer details</th>
<th>Description.</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mixed purpose interventions with a focus on good mental health (sleep) and physical activity levels.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Sony SmartBand Talk SWR30.**  
Sony  
(Japan/International) | • Tracks activities and sleep.  
• Data can be accessed via the display on the band or in more detail via the Lifelog connected app. | • Launched: Dec 2014.  
• Cost: £129.00.  
| **Basis Peak Tracker.**  
Basis  
(USA)  
(Acquired by Intel in May 2014.) | • Five sensors for heart rate, motion, perspiration and skin temperature.  
• Passive activity tracking with “BodyIQ” technology to detect users’ walks, runs, bike rides as well as sleep and wake times.  
• Advanced sleep analysis and healthy habits system for turning insights into action. | • Launched: Nov 2014.  
• Cost: £170.00.  
• [https://en-gb.mybasis.com/](https://en-gb.mybasis.com/) |
| **Samsung Gear Fit.**  
Samsung Electronics  
(South Korea/International) | • Band which monitors heart rate, steps taken, cycling and sleep.  
• Claims to adapt to users’ fitness levels as users train giving a recommendation for user’s next workout. | • Launched: Apr 2014.  
• Cost £180.00.  
| **Razer Nabu.**  
Razer  
(USA) | • Has an OLED display that sits on the underside of the wristband and will vibrate when users receive notifications.  
• It tracks activity, sleep and calories needed to burn to hit user’s personal goal.  
• It can communicate with other Nabu wristbands. Users can exchange contact information by tapping their bands together.  
• Have also launched an entry level version of the Nabu (the Razer Nabu X). | • Launched: Dec 2014.  
• Cost: Razer Nabu $ 99.99.  
• Cost: Razer Nabu X: $49.99.  
| **Microsoft smart band.**  
Microsoft  
(USA/Multinational) | • Monitors, heart rate, calories burnt and sleep quality. | • Launched: Oct 2014.  
• Cost: $199.  
| **Asus Zen Watch.**  
Asus in partnership with Google  
(Taiwanese/Multinational) | • Connects with an Android smartphone to act as a personal wellness manager.  
• Tracks heart rate, step counts, calories burnt, activity duration. | • Launched: Sept 2014.  
• Cost: $199.99.  
• [http://www.asus.com/uk/News/Ok0b3LK94bZPGCyn](http://www.asus.com/uk/News/Ok0b3LK94bZPGCyn) |
<table>
<thead>
<tr>
<th>Device Type</th>
<th>Features</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Apple Watch</strong>&lt;br&gt;Apple (USA)</td>
<td>- Allows user to set activity goals.&lt;br&gt;- Measures relaxation levels and provides a score with tips on increasing relaxation and reducing stress.</td>
<td>- Launched: March 2015.&lt;br&gt;- Costs: $349. [<a href="https://www.apple.com/uk/watch/health-and-fitness/">https://www.apple.com/uk/watch/health-and-fitness/</a>]</td>
</tr>
<tr>
<td><strong>Garmin smart watches and trackers</strong>&lt;br&gt;Vivoactive, Fenix3, Epix.&lt;br&gt;Garmin (Multinational)</td>
<td>- The ability to track multiple activities.&lt;br&gt;- For friends and family to track users’ activity real time.&lt;br&gt;- The Vivoactive features audible alert that remind users to get up and move.</td>
<td>- All launched in Quarter 1 2015.&lt;br&gt;- Costs: Vivofit 2 fitness band $129.99, Vivoactive watch $249.99, Fenix3 $499.99, Epix smartwatch $550.00. [<a href="http://garmin.blogs.com/my_weblog/2015/01/ces-announcement-2015-lineup-.html">http://garmin.blogs.com/my_weblog/2015/01/ces-announcement-2015-lineup-.html</a>]</td>
</tr>
<tr>
<td><strong>Vibe Band VB10.</strong>&lt;br&gt;Lenovo (Chinese/Multinational)</td>
<td>- Tracks activity and sleep.&lt;br&gt;- When connected to a companion device it gives notifications e.g. texts, Facebook, Twitter and WeChat.</td>
<td>- Launched: Apr 2015.&lt;br&gt;- Cost: $89.00. [<a href="http://news.lenovo.com/article_display.cfm?article_id=1880">http://news.lenovo.com/article_display.cfm?article_id=1880</a>]</td>
</tr>
<tr>
<td><strong>Alcatel One Touch Watch.</strong>&lt;br&gt;Alcatel (Chinese/French)</td>
<td>- Tracks calories, heart rate, steps and sleep.&lt;br&gt;- Allows sharing of information with others.</td>
<td>- Launched: Mar 2015.&lt;br&gt;- Cost: £109.99. [<a href="http://watch.alcatelonetouch.com/">http://watch.alcatelonetouch.com/</a>]</td>
</tr>
<tr>
<td><strong>GoBe™.</strong></td>
<td>- Claims to passively track calorie intake as well as monitor</td>
<td>- Launched: August 2015.</td>
</tr>
</tbody>
</table>
### Healbe

**Location:** US/Russia

- **Activity levels, sleep and stress levels.**
  - Uses an impedance sensor that sends high and low frequency signals through users' tissue to measure the fluid moving in and out of their cells. FLOW Technology uses an advanced algorithm to analyse this data and determine calorie intake.

- **Notes:**
  - It is unclear at time of writing whether the company has managed to obtain independent validation for this technology.
  - Available in US only.
  - Cost: from $299.99

### Moov

**Location:** USA

- **Moov is a "wearable coach" (band) that helps users with their workouts and tells them if they are exercising correctly.**

- **Notes:**
  - Launched Mar 2015.
  - Cost: $69.00.
  - Website: [http://welcome.moov.cc/](http://welcome.moov.cc/)

### Non-invasive monitoring techniques for glucose sensing, and dehydration using speckle technology.

**Details:** International collaborative research project.

- **A glucose and dehydration-monitoring watch.**
  - The sensor uses non-invasive changing patterns of scattered light to monitor glucose concentration and dehydration levels.
  - The watch-like device consists of a laser to generate a wave of light that illuminates a patch of skin on the wrist near an artery, and a camera that measures changes over time in the light that is backscattered off the skin.

- **Notes:**
  - Launch: Technology in development.

### Pulse monitoring technique that could be used for physical activity monitoring.

**Details:**

- **Watch like device that monitors pulse.**
  - The device can monitor pulse non-invasively with a sensor that isn’t thrown off by the wearer's movement.
  - The team is currently working with companies to integrate their technique into existing sensors, for potential use clinically as well as in sports.

- **Notes:**
  - Launch: Technology in development.
## Table 2: Internal /implantable wearables

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information:</th>
</tr>
</thead>
</table>
| **Helius. Proteus Digital Health (USA)** | Real-time tracking of medication adherence, rest and activity levels via ingestible sensor and linked platforms e.g. mobile phones. | Those on medical treatment plans. Possible application for monitoring other groups. | - The Proteus digital health feedback system combines wearable and ingestible sensor technologies that together are designed to help improve patients’ health habits.  
- Helius is an ingestible sensor which sends a signal to a patch worn on the torso; this patch then transmits data to secure smart phone or tablet app.  
- Detailed information, including when a medication has been taken as well as activity and rest patterns, is captured and delivered to a secure database.  
- The information is designed to help patients and their caregivers better manage their conditions and to help clinicians provide more effective care.  
- Technologies such as these could be used as early warning systems to monitor not only medicine adherence but other also activities e.g. activity levels for those on exercise therapy programmes.  
- **Health outcome**: By monitoring patient behaviours through Helius system, caregivers are better able to improve health outcomes.  
- **Behavioural change intervention**: through coercion and environmental restructuring.  
- Healthcare professional input required for use? Yes. | - The system received European regulatory approval (CE Mark) in Aug 2010.  
- The sensor technology received USA FDA market clearance as a medical device for co-ingested applications in July 2012.  
- Commercial pilots are underway in regions of the United States and United Kingdom.  
- Proteus is working in partnership with companies including Otsuka Pharmaceutical and Novartis, to further the development and future commercialization of Digital Medicines.  
## Table 3: Smart clothes

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information:</th>
</tr>
</thead>
</table>
| **The Polo Tech Shirt.** Ralph Lauren (USA & Worldwide) and OM Signal (Canada) | Smart Shirt that tracks biometric data and streams to smartphone or tablet app. | General public or sports person. | - The shirt measures heart rate and breathing rate via inbuilt sensors linked to a mobile phone app.  
- It will provide feedback to allow the user to stay in their desired heart rate zone.  
- **Health Outcomes:** Potential to improve physical wellbeing for users.  
- **Behavioural Change Intervention:** through training and information (device provides feedback).  
| **Athos gear.** Athos (USA) | Shirt and trousers combined with core unit that tracks biometric data and links to smartphone app. | General public or sports person. | - Features a small “core device” which weighs less than 20g and works with sensors to deliver data via Bluetooth to a smartphone. This slips into a pocket on the top of shorts and contains a 6-axis accelerometer for measuring movement during a workout.  
- **Health Outcomes:** Improved physical wellbeing for users.  
- **Behavioural Change Intervention:** via: training/information (device provides feedback).  
- Launched: Jan 2015.  
- Costs: The Athos Core is $199, shorts and shirts start at $99 each.  
- IOS only. Claim to develop for Android in the future.  
| **Hexoskin.** Hexoskin (Canada) | Smart shirt that tracks biometric data and links to app. | General public or sports person. | - When connected to the IOS Hexoskin app, the shirt provides access to real-time metrics including heart rate, breathing rate, minute ventilation, pace, steps, speed, distance and more.  
- Data readouts from the shirt can be accessed in their raw format, and an open data API allows users to utilize their own analytics software.  
- **Health outcome:** Potential to improve physical fitness leading to reduction in risk for major diseases.  
- **Behavioural Change Intervention:** Through training/information (device provides feedback).  
- Cost: $399.  
- The Hexoskin app is compatible with Android 4.0.4 and above, and IOS 7 and above and Desktop sync software compatible with Windows 7 and 8, Mac OSX 10.8 and above.  
- [http://www.hexoskin.com](http://www.hexoskin.com) | |
| **RUNSAFER.** Nuromedia GmbH (Germany) | Smart trainers with companion app and web portal to improve | General public. | - Uses a microelectronic measurement system embedded into the sole of the shoe to collect biomechanical data and transmit it via Bluetooth to a smartphone application.  
- The app will inform runners in real time about the performance achieved and make suggestions such as | |

### Physical activity interventions.

- Health Outcomes: Potential to improve physical wellbeing for users.
- Behavioural Change Intervention: through training and information (device provides feedback).
| Running techniques. | Changing the running pattern. | There is a web portal aspect to the project which allows users to transfer their running information into a 2.0 web portal for personalized training programmes.

**Health outcome:** Potential to improve physical fitness leading to reduction in risk factors for major diseases.

**Behavioural change intervention:** Through training and environmental restructuring.

**Healthcare professional input required for use?** No.

| Wi-Shoe project | Smart shoe & companion app. | This product has potential application in healthcare/rehabilitation and sports sectors. | The Wi-Shoe project aims to develop a completely non-intrusive wearable shoe-based system used for measuring kinematic gait parameters and energetic expenditure during various activities.

Data from the Wi-shoe will be wirelessly sent to a nearby smartphone for analysis and evaluation of the subject's condition and gait performance. The system has different levels of users, including expert support that can set-up the Wi-Shoe system and provides help and advice to the user. The system will also offer historical analysis of results and can be easily extended by combining it with additional wireless sensors.

**Health outcome:** Improved physical fitness leading to reduction in risk factors for major diseases.

**Behavioural change intervention:** through training and environmental restructuring.

**Healthcare professional input required for use?** No.

| Wi-Shoe project | Wi-Shoe project is supported by the European Commission through the Seventh Framework Programme (FP7-SME-2013, Grant agreement no: 605777) It is coordinated by CyRIC, Cyprus Research and Innovation Center Ltd. | This project started in Jan 2014 and is due to end in 2015.

**Cost:** circa €3000.


<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information:</th>
</tr>
</thead>
</table>
| **PerformTec®Heart Rate Earphones.**
LG (South Korea) | Heart rate sensing earphones. | General public. | • Combines an optimal emitter; photodetector and accelerometer fitted into an earbud. With accelerometer and blood-flow data algorithms can estimate, for example, number of calories burnt.
• Allows heart rate monitoring at the same time as using headphones to listen to music.
• The earphones are connected to a lightweight “medallion” device that can be strapped on the arm or clipped on a waistband which works as a data processing hub, sending real-time biometric information via Bluetooth to a Smartphone and/or LG LifeBand Touch activity tracker.
• **Health outcome:** Potential to improve physical health and reduce the risk of morbidity and mortality due to lifestyle related diseases.
• **Behavioural change intervention:** through environmental restructuring and enablement.
• Healthcare professional input required for use? No.
| • Launched: 2014.
• Cost: $179.99.
• IOS® 6 and IOS® 7 for iPhone® and iPod Touch®; Android™ 4.3 and 4.4; Android™ 4.2 for LG G2 and Galaxy S® 4 only.
| **Jabra Sport Pulse Headphones.**
(Powered by PerformTek™ technology)
Jabra (Denmark) | Heart rate sensing earphones. | General public. | • Uses an optomechanical sensor that shines light against the skin inside their ear to detect the pulse and oxygen consumption and generate a reading.
• Data sent directly to a connected Smartphone.
• The earphones can be used in connection with the Jabra SportLife App and other third party apps.
• Pace can be set according to goals and fitness levels and audio coaching can be accessed from Jabra Sport Pulse Wireless.
• Regular coaching tips come through automatically over music at key time and distance intervals, or the user can get instant updates by hitting a button on the left earbud.
• **Health outcome:** Potential to improve physical health and reduce the risk of morbidity and mortality due to lifestyle related diseases.
• **Behavioural change intervention:** through training, goal setting, environmental restructuring and enablement.
• Healthcare professional input required for use? No.
| • Launched: October 2014.
• Cost: $199.
• IOS and Android.
Table 5: Other wearables

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information:</th>
</tr>
</thead>
</table>
| **Ampstrip.**  
*FitLinxx (USA)* | Sensor based monitoring patch and companion app that tracks movement and exercise. | General public. | • A plaster like sensor worn on the left side of the chest where the heart beat is the strongest.  
• Tracks swimming, running and cycling with the partner app providing feedback on how hard you are working.  
• Health Outcomes: Potential to improve physical wellbeing.  
• Behavioural Change Intervention: via: training/information (device provides feedback).  
• Healthcare professional input required for use? No.  
• Undergoing beta testing and available for pre-order. Expected launch Jan 2016.  
• Cost: $135.  
• [http://www.ampstrip.com](http://www.ampstrip.com) | |
| **MC10 BIOStamp.**  
*MC10 (USA)* | Sensor based monitoring patch and companion app. | Possible application across a number of different groups. | • An ultra-thin flexible patch sensor that sticks to the body and can measure a number of physiological functions: data from the brain, muscles, heart, body temperature, and body movement. This data are then transmitted to an app, where it can be viewed and interpreted.  
• Can be used to track a number of conditions like heart failure, Parkinson’s and seizures. These sensors can also be used to encourage everyone to proactively measure their health. Applications could include a patch that lets an athlete know when, and how much, to hydrate for peak performance or one that tells users when to apply more sun cream.  
• The patch itself can be worn for several days, but user habits can affect the lifetime of the patch.  
• Health Outcomes: Potential to improved physical wellbeing for users across a number of different patient groups.  
• Behavioural Change Intervention: via: training/information (device provides feedback).  
• Healthcare professional input required for use? No.  
• MC10 announced in Sept 2014 that it has achieved ISO 13485:2003 certification for the design, development and distribution of activity and physiological monitoring devices.  
• According to the MC10 website the BIOStamp has not yet received FDA approval. (August 2015).  
• MC10 are also collaborating with partners in sports, fitness and healthcare to bring other products to market.  
| **Prana.**  
*Prana (USA)* | Sensor based wearable disk that tracks breathing and posture. | Possible application for stress management. | • This device is blue-tooth linked to a mobile app and clips onto the users’ trouser belt.  
• It uses a 3-axis accelerometer and algorithms to measure breathing and slouching patterns.  
• Prana learns how users breath and then makes | Patent is pending and Prana website indicates pre-ordering is available.  
• Cost: $149.99.  
• Available on Android and iOS.  
• [http://prana.co/](http://prana.co/) |
<table>
<thead>
<tr>
<th>Recommendations based on what they are doing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The Prana Clinical Mode offers either the user or their health practitioner data on how well (or poorly) they are breathing while sitting, standing and exercising throughout the day.</td>
</tr>
<tr>
<td>- Healthcare practitioners can also use the data generated to see if the user is sitting upright or mostly slouching to make an assessment.</td>
</tr>
<tr>
<td>- Contains gamification elements and a library of breath patterns to train against.</td>
</tr>
<tr>
<td>- <strong>Health Outcomes:</strong> Potential to improve physical and mental wellbeing for users.</td>
</tr>
<tr>
<td>- <strong>Behavioural Change Intervention:</strong> via training/information (device provides feedback/training) and incentivisation (gamification).</td>
</tr>
<tr>
<td>- <strong>Healthcare professional input required for use?</strong> Not essential but enhances use.</td>
</tr>
</tbody>
</table>
## APPENDIX 4: NON-WEARABLE TRACKERS

### Technology & developer details

<table>
<thead>
<tr>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mixed intervention: Sleep, nutrition, drinking and activity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• An app that can use the data automatically pulled from the sensors in mobile phones to build up a picture of user activity and user habits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Users can plug in third-party devices and services.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Allow the user to decide which information to use and share (including which apps can access users’ data through the Health app).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• When phone is locked with a passcode or Touch ID, all user health and fitness data in the Health app is encrypted.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Users can back up data to iCloud, where it is encrypted while in transit and at rest.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Health outcome</strong>: Potential to improve physical and mental fitness leading to reduction in risk factors for major diseases.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Behavioural change intervention</strong>: through training, education, goal-setting and incentivisation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Healthcare professional input required for use?</strong> No but the user report also can be shared with healthcare providers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Launched</strong>: Sept 2014.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Cost</strong>: Free with IOS 8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>IOS.</strong></td>
<td><strong><a href="https://www.apple.com/uk/ios/whats-new/health/">https://www.apple.com/uk/ios/whats-new/health/</a></strong></td>
<td></td>
</tr>
<tr>
<td><strong>Reactivate app. Grace O’Malley (Children’s University Hospital, Dublin) and Amanda Burls (City University London), (UK)</strong></td>
<td>A smart phone based change app.</td>
<td>Adolescents who are clinically obese. (May have application for other populations).</td>
</tr>
<tr>
<td>• Allows users to monitor their eating, drinking, activity and sleeping patterns, as well set goals.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Health Outcome</strong>: Potential for reduction in BMI leading to improved overall health and reduction in risk factors for serious disease later in life.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Behavioural Change Intervention</strong>: Self-monitoring, goal setting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Healthcare professional input required for use?</strong> No but is part of a trial.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Part of a 12-month randomised, controlled trial.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Positive mental health interventions

<table>
<thead>
<tr>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Xpression app. Ei Technologies Ltd and The University of East Anglia</strong></td>
<td>A smartphone based emotion from voice</td>
<td>Those suffering anxiety or depression.</td>
</tr>
<tr>
<td>• Aims to improve the effectiveness of psychological therapies, used to treat conditions such as depression and anxiety, through improving users’ awareness of changes in their emotions; a key barrier to effective treatment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Still being refined and is the recipient of a Technology Strategy Board inspired grant to improve robustness.</strong></td>
<td><strong><a href="http://gtr.rcuk.ac.uk/project/2C8D0EF-CE65-4049-A3CC-879318A50343">http://gtr.rcuk.ac.uk/project/2C8D0EF-CE65-4049-A3CC-879318A50343</a></strong></td>
<td></td>
</tr>
<tr>
<td>(UK) app.</td>
<td>The app uses algorithms, developed as part of a “Personal Emotion Recognition Engine” system, to interpret voice characteristics. Sends the information via WiFi or 3G to a secure cloud server. The cloud server subsequently creates a map of users’ mood. The analysis can be sent back to the user who reflects on the information and what they thought were the causes for their mood changes throughout the day. Results can be later discussed with a therapist. Alternatively, it could also send descriptive lists of the times an individual’s mood changed to the psychologist at the end of the day. <strong>Health Outcomes:</strong> Potential to improve mental wellbeing and reduce risk factors associated with poor mental health. <strong>Behavioural Change Intervention:</strong> Education (user awareness of mood changes) and persuasion (through contact with therapist). <strong>Healthcare professional input required for use?</strong> Yes for fuller use but can be used without.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>StudentLife. Andrew Cambell, Dartmouth College (USA)</td>
<td>A phone app with built in sensors to monitor mood. Current students but potential across a range of groups. Student Life app is part of a study which claims to be the first of its kind to use passive automatic sensing data from mobile phones to track mental health. The app monitors sleep, conversations, physical activity, location and length of stay e.g. class, party, gym, outdoor and indoor mobility, stress levels, positive affect (how good they feel about themselves), eating habits and app usage. Able to continuously make mental health assessment 24/7. <strong>Health Outcome:</strong> StudentLife app could form part of early interventions to promote healthy living improving general health, QoL and reducing risk factors for developing long term habits around drug used. <strong>Behavioural Change Intervention:</strong> The next iteration of the StudentLife App could inform students of risky behaviour. Providing this information could help change behaviours. <strong>Healthcare professional input required for use?</strong> Yes.</td>
<td></td>
</tr>
<tr>
<td>MoodRhythm Cornell University (USA)</td>
<td>An app that uses a diary to track moods and sensors to track Patients with bipolar disorder. Possible application for general</td>
<td>Uses an algorithm to detect sleep patterns based on activity and noise levels picked up by the phone including breathing patterns. Also contains a gyroscope and accelerometer to record activity levels. Gives users helpful advice to maintain a regular daily sleep pattern. <strong>Health Outcome:</strong> Potential to improve mental wellbeing and reduce risk factors associated with poor mental health. <strong>Behavioural Change Intervention:</strong> Education (user awareness of mood changes) and persuasion (through contact with therapist). <strong>Healthcare professional input required for use?</strong> Yes.</td>
</tr>
<tr>
<td>Healthy Minds. University of Southampton (UK) (funded by the Engineering and Physical Sciences Research Council)</td>
<td>An app to help combat stress and lift mood.</td>
<td>Users must be over 18.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>MiYo (Mind YourSelf). SpunOut.ie (UK) Funded by the National Office for Suicide</td>
<td>Self-reflective journal app.</td>
<td>Young people aged 16-25.</td>
</tr>
</tbody>
</table>
| Prevention, UK | • When users log the completion of an activity they earn points which help them to reach their goals. Maintaining a routine in each of the six activities also earns them badges.  
• If users are having difficulty reaching a particular goal, the app will suggest content on SpunOut.ie to get them back on track to a healthy lifestyle routine.  
• Health outcome: Potential to improve physical and mental fitness leading to reduction in risk factors for major diseases.  
• Behavioural change intervention: through training, goal setting and incentivisation.  
• Healthcare professional input required for use? No. |

| MoodMatters. Ginger.io (USA) | Smartphone app that helps users better understand their moods.  
Users have to be at least 18, own a mobile phone and be a resident of the United States to take part in the Mood Matters study.  
• This app has been used to help people with many conditions including IBD, depression and bipolar disorders.  
• Health outcome: Potential to improved physical and mental fitness leading to reduction in risk factors for major diseases.  
• Behavioural change intervention: through training and education.  
• Healthcare professional input required for use? No. |

| Booster Buddy. Island Health (Canada) | Mood tracking app for young people.  
Young adults and teenagers. Possible potential for older age groups.  
• The app allows users to manage their personal wellness journey and earn achievements as a “sidekick” guides users through a series of daily quests designed to establish and sustain positive habits. The app allows users to:  
  • Use coping skills.  
  • Keep track of appointments and medications.  
  • Get started on tasks.  
  • Follow self-care routines.  
  • Increase real-life socialization.  
• Health outcome: Potential to improve mental wellbeing leading to reduction in risk factors associated with poor mental health in young adults and teenagers.  
• Behavioural change intervention: through training, goal setting and education.  
• Healthcare professional input required for use? No. |

| Sleep improvement interventions | Withings Aura. Withings (USA) | Sleep monitoring sensor and associated app.  
General public.  
• Combines a sensor pad that is placed under the mattress alongside a bedside device.  
• The two units record and monitor a range of factors. The mattress based sensor monitors body movements, breathing cycles and heart rate whilst the bedside  
• Launched: Spring 2014.  
• Winner of the 2014 CES Innovation Aware in Health and Fitness Category.  
• Cost: $299.  
• IOS. Android version in development. |
<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>Users</th>
<th>Features and Benefits</th>
<th>Sources</th>
</tr>
</thead>
</table>
| **ResMed S+** | Non-contact sleep sensor and app that can integrate with Apple HealthKit. | Those suffering sleep disorders or wishing to improve their sleep health. | - ResMed claim that the S+ is the world’s first non-contact sleep system. The S+ uses patented bio-motion sensors, designed to measure an individual’s sleep stages and environment, and deliver personalized feedback. The system also captures the light, noise and temperature levels in the room and allows consumers to log factors such as caffeine and alcohol intake, as well as exercise, to analyse patterns over time and deliver personalized sleep strategies.  
- The free S+ by ResMed app provides sleep scores and analysis along with interactive tools that provide a range of options for a path to better sleep, including “Mind Clear” which allows users to record a voice clip, or type a text note to help clear their thoughts on the path to a good night’s sleep.  
- **Health outcome**: Potential to improve sleep leading to reduction in risk factors associated with sleep deprivation.  
- **Behavioural change intervention**: through training, goalsetting and education.  
- **Healthcare professional input required for use?** No but the user report also can be shared with healthcare providers. |  
- Cost: The S+ sensor unit is $149.99 and the S+ App is free.  
- In a management policy briefing, CEO of Nindento presented a new Quality of Life (QOL) platform to be released in 2016. According to the briefing, Nintendo has partnered with ResMed on the QOL platform and the ResMed technology will be used to send sleep data back to the QOL device. http://nintendonews.com/2014/10/qol-quality-of-life-cloud-servers/ (Accessed June 2015)  
| **Beddit**    | Non-wearable sleep sensor strip with associated mobile phone app. | General public wishing to improve sleep quality. | - The sensor device is placed directly on user’s mattress, under the sheets and works with companion Misfit app to provide users with feedback on their sleep.  
- The app provides visualizations of user data for daily and weekly trends. Users can also soothe themselves to sleep with a variety of custom, gentle sleep sounds and use the smart alarm to wake up in the users’ lightest stage of sleep. |  
- Launched: July 2014.  
- Cost: $149.99.  
• The sensor tracks total sleep time, sleep cycles, deep & light sleep duration, awake times, heart rate, ambient sound and snoring.
• Health outcome: Potential to improve sleep leading to reduction in risk factors associated with sleep deprivation.
• Behavioural change intervention: through training, goalsetting and education.
• Healthcare professional input required for use? No.
## APPENDIX 5: BRAIN TRAINING BIOFEEDBACK

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| **Emotiv Insight.** Emotiv (USA) | Brainwave tracking headset with accompanying mobile app. | Members of the public who wish to improve their cognitive health and wellbeing. | - The insight headset measures and tracks attention, focus, engagement, interest, excitement, affinity, relaxation and stress levels.  
- It uses five EEG and two other sensors including hydrophilic polymer biosensors which eliminate the need for extensive preparation and conductive materials by absorbing moisture from the environment.  
- Emotiv have developed some basic apps to demonstrate how the headset may potentially be used.  
- Has potential for changing both health outcomes and behaviour through apps such as the cognitive training app.  
  **Health Outcomes:** Potential for improved mental wellbeing.  
  **Behavioural Change Intervention:** Through training.  
  Healthcare professional input required for use? No.  
| - Launched: summer 2015.  
- Published papers from Emotiv's website. [http://emotiv.com/paper](http://emotiv.com/paper)  
- Pricing starting at $299.00 for headset with associated mobile apps ranging from $0 to $79.00.  
- Android, IOS, Mac, Linux and Windows.  
- Emotiv have made the source code available for other developers to take forward and develop new apps for use with the headset.  
- For a full list of apps available via the e-store. see: [https://emotiv.com/insight.php](https://emotiv.com/insight.php) |
| **MUSE.** Interaxon (Canada) | Brainwave tracking headset. | General public. | - Muse is a headband that connects wirelessly to a smartphone or tablet via Bluetooth and detects brainwaves using EEG sensors.  
- It allows users to perform interactive exercises to help users settle and calm their mind.  
- According to the developers, by tracking the brain’s performance over time a reduction in stress and anxiety, increased focus, and improved emotional intelligence can be achieved.  
  **Health Outcomes:** Potential to improved mental wellbeing.  
  **Behavioural Change Intervention:** Through training.  
  Healthcare professional input required for use? No.  
| - MUSE has won the International CES Innovations 2013 Design and Engineering Award for ‘Tech for a Better World’.  
- Launched early 2014.  
- IOS and Android.  
- Cost: $299.  
| **iFocusBand.** iFocusBand (USA) | A headset for mental health skills training using | Currently being tested by professional | - The user wears the headset which gathers data using EEG sensing devices to measure brainwaves.  
- The feedback is provided in audio and visual format |
| - Current prototype being tested by golf pros to improve performance. Has been available to order from July 2015. |
| Neuro-feedback. | Sports people to increase competitive edge. Has possible application for general public. | (in the form of an avatar when used with companion app) to help improve state of mind. • Can also link to cloud to get further tips, games and competitions. • Can work as standalone wearable device or can link to companion app and/or cloud. • **Health outcome:** Potential to increase wellbeing levels. • **Behavioural Change Intervention:** Training. • **Healthcare professional input required for use?** No. | • **iOS, Android & Windows.** • Cost: The iFocusBand Headset & Cap, iFocusBand Blueprint and iFocusBand App can be bought together for $310. • [http://www.ifocusband.com/](http://www.ifocusband.com/) |
| Shift. SHIFT (UK) | Biofeedback gaming device. | Shift are developing a video game that measures and interacts with a player’s emotional state, prompting and rewarding them for controlling this through regulated breathing. • This is done by harnessing data from wearable sensors that measure heart rate variability (HRV). According to the developer website the game is underpinned by clinical evidence that demonstrates the effect that regulated breathing can have on stress and anxiety. • **Health Outcomes:** Potential to increase wellbeing levels. • **Behavioural Change Intervention:** Biofeedback training and incentivisation (through gaming). • **Healthcare professional input required for use?** No. | • Prototype developed and tested between autumn 2014 and autumn 2015. • Shift was a finalist in the 2014 Google Impact Challenge and has received funding from this as well as being partnered with Playlab London, 2CV, Complete Coherence Ltd and the Nominet Trust. • [http://www.shiftdesign.org.uk/products/biofeedback-video-game/](http://www.shiftdesign.org.uk/products/biofeedback-video-game/) |
| Rupa. Rohan Gunatillake (UK) | A wearable biofeedback device worn around the ankle for mindfulness training. | A non-verbal way of training mindfulness. Uses sensation of pressure and vibration to remind the user to stay grounded. • **Health outcome:** Potential to increase wellbeing levels. • **Behavioural Change Intervention:** Biofeedback training and incentivisation (through gaming). • **Healthcare professional input required for use?** No. | • According to the developer, Rupa was a prototype commission for the UK “Wearable Futures” event last year. It is not in their current plans to take to full launch in 2015. • [https://wearablefutures10.squarespace.com/#/rohan-gunatillake/](https://wearablefutures10.squarespace.com/#/rohan-gunatillake/) |
| The Pip. Galvanic Ltd (Ireland) | Handheld sensor linked to app games for stress management. | Aims to develop stress management skills through biofeedback. • The user’s stress levels are measured by the PIP handheld device (sensing electrodermal activity in the hand) and this is used to determine their performance in the games. • There are two games currently available: • The "loom" game turns winter into summer through relaxation. • The "relax and race" game users have to relax to win. • By using the gaming applications as the delivery for | • Launched: summer 2014. • Pip supports IOS and Android. Future Pip plans to support Windows Phone, BlackBerry, Personal Computers (Windows/Mac OS) Games Consoles/ Set-top Boxes). • Cost: €179. • [http://www.thepip.com/](http://www.thepip.com/) |
the biofeedback, the user learns to manage their stress, while having fun at the same time.
- Gamification and biofeedback are combined to allow users to consciously monitor their stress levels.
- **Health outcomes**: Potential to reduce stress levels and associated ill health.
- **Behavioural Change Intervention**: Biofeedback training, education and Incentivisation.
- **Healthcare professional input required for use?** No.
<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mixed purpose intervention: Activity levels, medications adherence, healthy eating</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Txt4Health. Voxiva Inc (USA) | Personalized text messaging service. | Personal health plan users in USA. | • Personalised messages to help people follow recommended preventive care guidelines, remember to take medications and attend medical appointments, track weight and exercise goals, and learn healthy eating and nutrition tips.  
• When users sign up they are asked questions that will help to build a health profile. Txt4health will send around one message per week based on their answers. User can access further functionality by choosing to play fun health quizzes or trying a 30-day healthy challenge.  
• **Health outcomes:** Potential for improved general health leading to improved QoL.  
• **Behavioural Change Intervention:** Incentivisation and information/education.  
• **Healthcare professional input required for use?** No. | • Launched May 2014.  
• Text-based service.  
• Only available in US.  
• Free to personal health plan users in USA.  
| **Positive mental health intervention** | | | | |
| Mini-Me. FACT (UK) | Mood management app. | Young people (no age range specified) with mental health issues. | • The app asks users each day to grade their mood in a traffic light system of red, amber or green.  
• If they are green they will win online virtual rewards.  
• If they are amber then Mini-Me will show them photos, videos or play music that they have pre-loaded, in an attempt to improve their mood. If they rate themselves as red then Mini-Me will automatically send a text message to friends/family that they have pre-loaded, telling them the user is in a bad place and needs some help.  
• Users can use Mini-Me as many times a day as they wish but Mini-Me will remind them to log on each day, as they must use it at least once a day.  
• They can also enter their own thoughts at any time which will be saved on a timeline with colour grades, so users can review their mood and maybe understand or help manage them.  
• **Health Outcome:** Potential to improve mental health | • This technology was developed as part of the Innovation Labs initiative funded by Comic Relief.  
• Launched 2014.  
• Cost: Free.  
• [http://www.mini-me.org.uk/](http://www.mini-me.org.uk/) |
<p>| Kindly app. | Anonymous chat app. | General public. | Users can share or receive short conversation prompts in categories like &quot;addiction/recovery,&quot; &quot;marriage/divorce,&quot; &quot;work/business&quot; and &quot;creativity/inspiration.&quot; | The app then makes use of an algorithm to try and match the person who put out the prompt with another who may serve as a good listener. | Within minutes users are matched with a stranger for a 15-minute session. | To improve the number and quality of &quot;listeners&quot; in the app, the developer has recruited a number of psychology students from the University of Southern California, Vassar College and New York University. | The app makes it clear that it is not a crisis hotline, it is not intended to help users find love and it doesn't connect users with therapists. | Health outcomes: Potential for improved general wellbeing leading to improved QoL. | Behavioural Change Intervention: Through persuasion and environmental restructuring. | Healthcare professional input required for use? No. | But next phase of app development may require professional input. | Launched: July 2014. | Next phase of app development is to bring in experts and vetted professionals. | IOS. | Cost: Free. | <a href="http://kindlychat.com/">http://kindlychat.com/</a> |
| MoodBug. | App that helps people track and share their moods with close friends and family, and send e-gifts to show them care. | General public. | The app allows users to monitor mood shifts with check-ins and mood-maps. | The system plots mood and energy levels so users can create their own mood-map and share across their network. | Users can also connect with contacts for a quick and simple way of really staying in touch. | They can personalize their network and choose who they share with: they can keep their moods private, or share with strangers. | Users can also keep up with how their friends are feeling by checking out their network’s mood-map. | Free e-gifts are available to send and receive from people within their network as a way of showing support. | Health outcomes: Potential for improved general mental health leading to improved QoL. | Behavioural Change Intervention: Environment restructuring, persuasion and education. | Launched: June 2014. | Built for iPhone, plans to build for Android and Blackberry also. | Available on NHS health apps library <a href="http://apps.nhs.uk/app/moodbug/">http://apps.nhs.uk/app/moodbug/</a> | Cost: Free. | <a href="http://moodbug.me/">http://moodbug.me/</a> |</p>
<table>
<thead>
<tr>
<th><strong>Goal setting intervention</strong></th>
<th><strong>Healthcare professional input required for use?</strong> No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Help me do it!</strong>&lt;br&gt;University of Glasgow&lt;br&gt;(NIHR funded project)</td>
<td><strong>Starting in Jan 2015. To be completed by Jan 2018.</strong>&lt;br&gt;<strong>Part of a primary research project funded by the NIHR.</strong>&lt;br&gt;<strong>Web and text based intervention</strong>&lt;br&gt;<a href="http://www.nets.nihr.ac.uk/projects/phr/1218020">http://www.nets.nihr.ac.uk/projects/phr/1218020</a></td>
</tr>
<tr>
<td><strong>Helpmedoit! a web and text based intervention to facilitate social support to achieve and maintain health related behaviour change.</strong></td>
<td><strong>Health outcomes:</strong> Potential for improved general mental health leading to improved QoL.&lt;br&gt;<strong>Behavioural Change Intervention:</strong> Incentivisation and persuasion.&lt;br&gt;<strong>Healthcare professional input required for use?</strong> No.</td>
</tr>
<tr>
<td><strong>Members of the public wishing to change an “unhealthy” behaviour.</strong></td>
<td><strong>Physical activity based interventions</strong></td>
</tr>
<tr>
<td><strong>Helpmedoit! will be a website that will help people set a behaviour change goal and sign up friends or family as helpers to help them do it.</strong>&lt;br&gt;<strong>These helpers will then be prompted by text messaging to enthuse, support or commiserate and help the person to achieve their goal. Helpers can choose how they provide support: it could be via SMS, phone call or face to face.</strong>&lt;br&gt;<strong>Health outcomes:</strong> Potential for improved general mental health leading to improved QoL.&lt;br&gt;<strong>Behavioural Change Intervention:</strong> Incentivisation and persuasion.&lt;br&gt;<strong>Healthcare professional input required for use?</strong> No.</td>
<td></td>
</tr>
<tr>
<td><strong>Fitt. Fitt (USA)</strong></td>
<td><strong>Released June 2014.</strong>&lt;br&gt;<strong>Cost: Free.</strong>&lt;br&gt;<strong>IOS with plans to build for Android in the future.</strong>&lt;br&gt;<a href="http://fi.tt/">http://fi.tt/</a></td>
</tr>
<tr>
<td><strong>Fitness competition app.</strong></td>
<td><strong>Members of the public wishing to improve their overall fitness.</strong></td>
</tr>
<tr>
<td><strong>Fitt is built around the idea of challenges. It collects data from Fitbits, Jawbone UPs and the step-tracking app Moves (the company plans to add additional sources in the future) and allows users who use those tools to compete with one another.</strong>&lt;br&gt;<strong>For example, users can challenge others to walk a certain percentage more per day than their average, which Fitt calculates for them.</strong>&lt;br&gt;<strong>Health outcomes:</strong> Potential for improved general health leading to improved QoL.&lt;br&gt;<strong>Behavioural Change Intervention:</strong> Through incentivisation and modelling.&lt;br&gt;<strong>Healthcare professional input required for use?</strong> No.</td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX 7: COMPLIMENTARY INTERVENTIONS

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| **M-image. Kavanagh (Queensland University) and Andrade and May (Plymouth University). (CLAHRC funded)** | Motivational support app. | For those wishing to achieve lifestyle change including weight management, addiction, and physical activity changes. | - Supports “Functional Imagery Training” that uses mental imagery to motivate change.  
- Claims to enhance motivation and trains imagery skills rather than simply tracking.  
- Combined with more traditional therapies the app aims to change the way people think.  
- **Health outcomes**: Potential for improved general health leading to improved QoL.  
- **Behavioural Change Intervention**: Through incentivisation, training and modelling.  
- **Healthcare professional input required for use?** Yes.  
- In development.  
- A South West Peninsula CLAHRC funded project will assess the feasibility and acceptability of the app then run a RCT in an overweight sample.  
- The next step will be to apply for funding for a multi-centred RCT of combined interventions plus app before a full launch.  
- Android/iOS.  
- The project has cost £600k for development of app but the app will be free or of minimal cost. [http://clahr-peninsula.nihr.ac.uk/functional-imagery-training-as-a-personalized-e-health-intervention-for-weight-loss](http://clahr-peninsula.nihr.ac.uk/functional-imagery-training-as-a-personalized-e-health-intervention-for-weight-loss) | |
| **Modifying Alcohol Consumption to Reduce Obesity (MACRO): developing and feasibility testing of a complex community-based intervention for men. Professor Iain Crombie, University of Dundee (Funded by the NIHR)** | Mixed methods intervention to modify alcohol consumption to reduce obesity in men. | Men who: are aged 35-64 years; who regularly consume >21 units of alcohol per week; and are obese (BMI>30). | - A key feature of the intervention is an emphasis on the benefits of weight loss including body image.  
- Face to face sessions will be complimented by mobile phone messages.  
- The intervention is based on reviews of successful behaviour change strategies and will be designed to:  
  - Increase men’s awareness of their susceptibility to health problems caused by overweight and obesity.  
  - Increase their motivation to lose weight by reducing alcohol consumption.  
  - Gain commitment to changing drinking patterns.  
  - Encourage them to set goals and action plans to do so.  
  - Increase refusal skills.  
  - Implement strategies to prevent relapse.  
- **Health outcomes**: Potential for improved BMI leading to reduction in risk factors for health problems caused by overweight and obesity.  
- **Behavioural Change Intervention**: Incentivisation, information and training.  
- **Healthcare professional input required for use?** Yes.  
- Primary Research in progress funded by NIHR.  
- Project runs from May 2014 – Aug 2016.  
- [http://www.nets.nihr.ac.uk/projects/hta/1213912](http://www.nets.nihr.ac.uk/projects/hta/1213912) | |
<table>
<thead>
<tr>
<th><strong>Weight management intervention</strong></th>
<th><strong>Positive mental health interventions</strong></th>
</tr>
</thead>
</table>
| **POWeR Tracker.** UBHave Partnership between University of Southampton and Public Health Networks in the north | **Pesky gnats cognitive behaviour therapy.**
  Handaxe Ltd (UK) (Not for profit company) Supported by SBRI Healthcare through a research project at the University of Bristol. |
| **Weight management app which supports web-based weight management programme (POWeR) via goal setting and updates.** | **CBT based computer game and companion smartphone app.**
  Children/adolescents aged 9-15 with persistent mental health issues. May have wider application. |
| **No information provided.** | **In this computer game, players “visit” gNAT’s Island, and meet a team of wildlife explorers.**
  In each session a member of this team introduces a Cognitive Behavioural Therapy (CBT) concept and illustrates it through conversation, animations, videos and questions. The CBT concepts such as ‘negative automatic thoughts’ are presented as little creatures called ‘gNATs’ that can sting people, while ‘cognitive monitoring’ becomes gNAT trapping, and ‘core beliefs’ are discovered through hunting gNATs back to their hives.
  The ‘player’ then applies the concepts to their current difficulties, with help from their mental health professional, and reports their ideas to the game characters.
  The smartphone/tablet app may be used between sessions to help transfer in-session learning to everyday life at home or school. |**Health outcome; Potential to improve mental health.**
**Behavioural Change Intervention:** Through incentivisation and training.
**Healthcare professional input required for use?** Yes. |
| **POWeR offers users of the POWeR (web-based system) the opportunity to keep track of their personal POWeR goals via their mobile phone. It provides a range of tools that are designed to enhance users’ awareness of and motivation to work towards their personal POWeR goals in between completion of the web-based weekly POWeR sessions.** | **Launched: Beta tested in July 2014 and fully available for NHS use from Jan 2015.**
**Cost:** Software and app are being made available free of charge. |
| **Health outcomes:** Potential to improve BMI leading to improved QoL and reduction in disease risk factors. **Behavioural Change Intervention:** Incentivisation, environmental restructuring. | **Article:** Coyle D, McGlade N, Doherty G et al. Exploratory evaluations of a computer game supporting cognitive behavioural therapy for adolescents. ACM CHI 2011, 2937-2946.
  [http://dl.acm.org/citation.cfm?id=1979378](http://dl.acm.org/citation.cfm?id=1979378)*
**Article:** Twomey, C, Byrne M and O’Reilly G. Innovative ways to help increase access to CBT. Innovation in Practice Forum 2013, 40-41
**HSRIC technology alert:**
**Related funding:** UBhave: ubiquitous and social computing for positive behaviour change [http://gow.epsrc.ac.uk/NGBOViewGrant.asp?ref=EP/I032673/1](http://gow.epsrc.ac.uk/NGBOViewGrant.asp?ref=EP/I032673/1)
| **POWeR Tracker was rolled out in 2014 alongside the online POWeR programme to workplaces across the North East of the UK, in collaboration with local public health teams.** | **POWeR Tracker was rolled out in 2014 alongside the online POWeR programme to workplaces across the North East of the UK, in collaboration with local public health teams.**
**http://www.controlled-trials.com/ISRCTN15997004.**
| **Buddy App.**
  Sidekick Studios (UK) | **Buddy App.**
  Sidekick Studios (UK)
  Currently on the NHS Health apps library and available for NHS use from Jan 2015. |
| **Text messaging mental health support service to monitor/encourage** | **Text messaging mental health support service to monitor/encourage**
  People with depression and anxiety, and in Early Intervention |
| **People with depression and anxiety, and in Early Intervention** | **People with depression and anxiety, and in Early Intervention**
  An SMS and web-based application.
  Allows users to maintain a daily diary to record moods and activities. It contains an analysis tool that enables users to reflect on and understand their own condition.
  It allows for session planning by reminding users of their personal POWeR goals. |
| **An SMS and web-based application.**
  Allows users to maintain a daily diary to record moods and activities. It contains an analysis tool that enables users to reflect on and understand their own condition.
  It allows for session planning by reminding users of their personal POWeR goals. | **An SMS and web-based application.**
  Allows users to maintain a daily diary to record moods and activities. It contains an analysis tool that enables users to reflect on and understand their own condition.
  It allows for session planning by reminding users of their personal POWeR goals. |
| **Launched:** According to the developers Buddy is currently being rolled out nationally with a number of NHS trusts.**Currently only available to clinicians.**
**Buddy listed on the NHS Health apps library.** | **Launched:** According to the developers Buddy is currently being rolled out nationally with a number of NHS trusts.**Currently only available to clinicians.**
**Buddy listed on the NHS Health apps library.** |
| **i-Corps: Self-adherence and Self-motivated Training for Dealing with Post-Traumatic Stress; A smartphones solution.**<br>The Research Foundation of State University of New York (USA) Awardee of funding for app development from National Science Foundation. | **Companion, mindfulness and stress reduction app.**<br>Those with PTSD or other anxiety disorders. | **The app helps a therapist connect to clients and track progress between sessions. It will also ensure clients receive guidance in their daily monitoring and improvement.**<br>**Health outcomes:** Potential to improve stress levels leading to improved QoL.<br>**Behavioural Change Intervention:** Training, environmental restructuring, persuasion.<br>**Healthcare professional input required for use?** Yes. | **Buddy is compliant with the NHS Information Governance toolkit and all Information Governance and security requirements within the NHS.**<br>Buddy is sold in 12 month licence bundles of a minimum 500, with each licence costing £50. Additional discounts are available on volume purchasing.<br>http://www.buddyapp.co.uk/ |
### Physical activity interventions

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| **Sandpit: Smart e-bikes** - understanding how commuters and communities engage with electrically-assisted cycling. University of Brighton. Funded by the Research Councils UK Energy and Digital Economy Programmes, EPSRC Reference: EP/J004855/1 | E-bike connected to Smart e-bikes monitoring system (SEMS). SEMS is a platform for the real-time acquisition of usage data from electrically-assisted bikes. | Those currently physically relatively inactive and those currently not attracted to cycling. | • Involves a fleet of 35 electrically assisted bikes, 6 of which are additionally kitted out as “smart e-bikes” augmented with cameras, mobile phones and other sensors as part of any ongoing trial to investigate how smart bikes could contribute to meeting carbon reduction and public health objectives.  
   • It allows for continuous monitoring of e-bikes with no interaction by users required (i.e. no switching on or charging).  
   • Tracks mileage and use of assistance and other sensor data to feed back for (a) research analysis and (b) user feedback.  
   • The data feeds an online interface for data analysis, for riders to view their own data and for sharing on social media.  
   • Future sensor integration could include health related sensors, e.g. heart rate, air quality.  
   • **Health outcome:** May encourage more people to cycle or to cycle more so improving physical activity levels leading to reduction in risk factors for major diseases.  
   • **Behavioural change intervention:** through monitoring, goal setting and environmental restructuring.  
   • **Healthcare professional input required for use?** No.  
   • The project ended in Nov 2014. Any findings are to be disseminated via the project website.  
   • Article: Behrendt, F., S. Cairns, D. Raffo, and H. Clare. Electrically-Assisted Bikes: The Impacts on Cycling Behaviour: (Paper in draft)  
   • Article: Cairns, S., F. Behrendt, D. Raffo, and C. Harmer. Electrically-Assisted Bikes: The Impacts on Cycling Behaviour: (Paper under review)  
   • Article: Kiefer, C., and F. Behrendt. An Open-Source and Open Hardware Platform for Real-Time GPS, Assistance and Sensor Data Collection for Electrically-Assisted Bicycles : (Paper under review)  
   • Web-access through all platforms for users, Android used on on-bike SEMS phones.  
   • The source code and hardware design are publicly available, under the GPL license, for non-commercial use.  
   • http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/J004855/1  
   • http://www.smart-ebikes.co.uk/ | |

| **Revvo Exercise bike. Revvo Inc (US)** | **Smart/Connected Exercise Bike.** | Adults with lifestyle induced chronic condition. | Bike intelligently guides users to workout at just the right intensity to trigger a rapid increase in their (cardiorespiratory) fitness.  
   • Also tracks the resulting increase in fitness.  
   • Bio-adaptive technology picks the intensity that is just right for the user and then adapts protocol during and across sessions.  
   • **Launch:** US and international launch to key markets including UK in late 2015.  
   • Fully functional prototype being tested.  
   • Small production run in November 2014 to support early clinical trials amongst type 2 diabetes patients in partnership with Joslin Diabetes Centre (affiliated to Harvard Medical School). | |
- Manufacturer claims that Revvo is able to induce 2-3x greater reduction in blood pressure compared to conventional exercise programs.
- **Health outcome:** Improved physical health by normalising conditions such as diabetes and hypertension. Reduce the risk of morbidity and mortality due to CVD.
- **Behavioural change intervention:** through environmental restructuring and enablement.
- **Healthcare professional input required for use?** No.

| Smart Mirror . USEFIL project USEFIL (Europe) | Remote monitoring of health via “Smart Mirror”. | Currently older people for remote monitoring but has potential application for public health. | Smart mirrors equipped with low-cost wireless video cameras allow regular remote monitoring of health without need to engage with technology beyond looking in the mirror.
- **Health outcome:** Improved monitoring helps to encourage earlier intervention leading to improved health outcomes.
- **Behavioural change intervention:** through environmental restructuring
- **Healthcare professional input required for use?** Yes.


---

### Smoking reduction intervention

| Smokio. Smokio (France) | Smart Vaporiser and companion app | Anyone interested in giving up smoking. | Contains a small chip and Bluetooth connector that enables users to link the device to their smartphones. The cigarette then tracks each time it’s used and how much nicotine is being vaped, sending the data to the companion app.
- Users can check when and where they most often feel they need a nicotine boost in order to help control it.
- Users can also see how often they succumb to an electronic drag and how their habit compares both financially and health-wise — including a running tally of the number of days they’ve added to their life expectancy — to smoking a real cigarette.
- The level of nicotine can also be increased or reduced through the app. | **Launched:** Apr 2014
- **Android and IOS**
- **Cost:** from $79.90
- **Health outcome**: Smoking reduction or cessation leading to reduction in risk factors for major diseases
- **Behavioural change intervention**: through incentivisation and environmental restricting
- **Healthcare professional input required for use?** No
# APPENDIX 9: ADHERENCE INTERVENTIONS

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| **Automated Dot.** Aicure (NIH funded) (USA) | Provides DOT (Directly observed therapy) for medication adherence via mobile devices or Saas. | Patients who need to adhere to medication routines. May have application for public health. | • Aicure takes traditional directly observable therapy and makes it mobile through advanced facial recognition and motion sensing software.  
• Also educates and reminds patients to follow medication protocols.  
• Platform can work on any smartphone to automatically detect whether the person is taking their medication as prescribed without the need for human supervision.  
• Patients who take incorrect doses or do not use the software are automatically flagged for immediate follow-up.  
• **Health Outcomes:** Potential to improve health through increase in adherence to medication programme – possible application for public health e.g. exercise compliance.  
• **Behaviour Change Intervention:** coercion, education and persuasion.  
• **Healthcare professional input required for use?** Yes.  
• Launch: Aicure is starting a major clinical trial to monitor and intervene with patients receiving medication as maintenance therapy for opioid addiction.  
• This is being carried out with the Cincinnati Addiction Research Center (CinARC) at the University of Cincinnati. A total of 130 participants will be enrolled over the course of 12 mths. Preliminary results of the trial are expected to be published in second half of 2015.  
• App or SaaS deployments available.  
• [https://www.aicure.com/population.php](https://www.aicure.com/population.php) | |
| **Spruce.** British Liver Trust (UK) | App to encourage behavioral change in alcohol consumption. | Young Adults (18-30 year olds) | • Don’t have to track units, simply aim for three alcohol free days per week which the app helps users to record and sends reminders and nudges to ensure compliance.  
• **Health Outcome:** Potential to reduce ill health associated with alcohol consumption.  
• **Behavioural Change Intervention:** Information, goal setting.  
• **Healthcare professional input required for use?** No | • Released 22nd June 2014.  
• IOS.  
• Cost: Free.  
• [http://loveyourliver.org.uk/spruce/](http://loveyourliver.org.uk/spruce/) | |
| **Interactive text messaging programme for prevention of hazardous alcohol use.** Brown University, University of Pittsburgh (USA) | A text-based system for prevention of hazardous alcohol consumption. | Adolescents and young adults at risk for hazardous alcohol consumption or in whom high-risk alcohol | • A targeted program based around 3 established health behaviour models.  
• It uses an interactive text message system cued to high-risk binge drinking periods.  
• It includes follow up messages to promote positive alcohol use behaviours (e.g. motivational messaging, abstinence support and passive positive reinforcement) | • Launched: 2014.  
| **ACHESS.** Center for Health Enhancement Systems Studies, University of Wisconsin-Madison (USA) | **App-based intervention for Alcohol dependence with companion RCT.** | **People with alcohol dependence.** | **ACHESS will be delivered through a smart-phone and will focus on helping alcohol dependent patients leaving residential care with information and other resources.**  
**ACHESS will, offer optional audio delivery to improve access for those who have literacy challenges and be enhanced with services tailored towards relapse prevention.**  
**ACHESS will also offer:**  
1) Communication with peer support groups and addiction experts.  
2) Timely monitoring to assess risk of relapse.  
3) Reminders and alerts to encourage adherence to therapeutic goals.  
4) Individualized addiction-related educational material and tools tailored to the needs of the particular patient.  
5) Access to selected Internet-based resources.  
6) One-touch communication with a care manager.  
**Health Outcome:** Potential to improve competence, relatedness, and autonomy which will reduce the days of risky drinking over a 12-month period.  
**Behavioural Change Intervention:** Goal setting/incentivisation and information.  
**Healthcare professional input required for use?** Yes. |
| --- | --- | --- | --- |

**Smoking cessation interventions**

| **Intelliquit. Intelliquit (USA)** | **Biofeedback sensor to encourage smoking cessation.** | **Smokers wishing to give up.** | **A lighter-sized wireless device that measures carbon monoxide in smokers' breath.**  
The carbon monoxide levels indicate the amount of smoking related toxins in the body which decrease as consumption is reduced.  
The device connects to an app that uses voice recognition technology to log when and where the smokers are smoking.  
This helps smokers recognize patterns in their smoking behaviour and sends reminders/prompts via text |
| --- | --- | --- | --- |

| **ACHESS** | **Android.**  
**Part of a randomised clinic trial "ACHESS" developing and testing a mobile phone-based relapse-prevention system.**  
**https://chess.wisc.edu/achess/app/** |
| --- | --- | --- | --- |

| **Intelliquit** | **Launch: Prototype in development.**  
**Designed to be platform agnostic and work with any pre-existing smoking cessation app, programme or e-cig.**  
**http://www.intelliquit.org/** |
| **Smoke – free quit smoking now.** David Crane 23 Ltd (UK) | **Smoking cessation app.** | Smokers wishing to stop smoking. | • The app incentivises smoking cessation through a “dashboard” display that features goal setting, progress checks (such as a running total of money saved by not smoking) and updates around health improvements obtained via smoking cessation (e.g. hours of life gained).  
• Users can earn “badges” for their progress and share with friends via social media.  
• There is also a diary aspect that allows them to record their cravings.  
• **Health Outcome:** Potential to reduced ill health associated with smoking.  
• **Behavioural Change Intervention:** Through goal setting, incentivisation and information.  
• Healthcare professional input required for use? No.  

---  

| **SmartStop.** Chrono Therapeutics (USA) | **Wearable NCT device with Bluetooth link to SmartStop app.** | Smokers. | • SmartStop is a wearable device that offers programmable, transdermal nicotine replacement therapy (NRT) in combination with real-time behavioural support.  
• Chrono Therapeutics asserts that research has shown that smokers have clear, consistent and predictable daily peak nicotine craving patterns.  
• SmartStop is designed to automatically vary nicotine levels throughout the day to match those patterns.  
• The device uses Bluetooth technology to wirelessly communicate with the SmartStop digital support program, providing real-time guidance to help smokers cope with cravings as well as a means for promoting compliance to the NRT and overall quit process.  
• **Health Outcomes:** Potential to increase success rates in smoking cessation so reducing risk factors for smoking related diseases.  
• **Behavioural Change Intervention:** Information and training.  
• Healthcare professional input required for use? No.  

---  

| **Quitbit.** Quitbit USA | **Smartphone connected lighter for cigarette** | Smokers. | • Internet of Things type product which allows passive tracking of smoking habits along with a wireless connection to a mobile app which provides additional features.  

---  

| • The app has been available to download since Sept 2014.  
• Users can agree to their data being used to inform future developments. As part of this some additional features are made available to different users to see if they help the smoking cessation process.  
• This app is the Winner of a UCL award as part of a UCL “digital health festival event in 2014.  
• Free to download.  
• IOS and Android.  
| • Available for pre-order.  
• Estimated shipping date October 2015.  
• Cost: $99.  
• iPhone 4s/5/5s and Android 4.3. |
<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Target</th>
<th>Benefits</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quitbit Lighter</td>
<td>Works as a standalone device to provide real-time feedback through its display. However, the app is needed to unlock additional features like setting goals, and viewing trends. Users can view smoking history, set reduction plans, and optionally limit how often and when the lighter can be used. <strong>Health Outcome:</strong> Potential to reduced ill health associated with smoking and reduction in risk factors for smoking related diseases. <strong>Behavioural Change Intervention:</strong> Through goal setting and information. <strong>Healthcare professional input required for use?</strong> No.</td>
<td>Smokers</td>
<td></td>
<td><a href="http://quitbitlighter.com/">http://quitbitlighter.com/</a></td>
</tr>
<tr>
<td>SmartQuit 2Morrow (USA)</td>
<td>Offers an Acceptance and Commitment Therapy (ACT) based approach to quitting. It is delivered completely over a smartphone and participants can also earn a Certificate of Completion that may save them money on healthcare premiums with some employers. <strong>Health Outcomes:</strong> Potential to increase smoking cessation rates and decrease risk factors for smoking related diseases. <strong>Behavioural Change Intervention:</strong> Persuasion and coercion. <strong>Healthcare professional input required for use?</strong> No.</td>
<td>Smokers</td>
<td></td>
<td>Launch: The app was launched Nov 6th 2014 <a href="http://2morrowinc.com/news.php">http://2morrowinc.com/news.php</a> According to the developers SmartQuit is the first app proven to be effective in an RCT to help smokers quit. Article: Bricker JB, Mull K, Vilardaga R et al. Randomized, controlled trial of a smartphone app for smoking cessation using Acceptance and Commitment Therapy. Drug Alcohol Depend 2014; 143 87–94. Cost: There is a free LITE version and a full programme version that costs $50 for six mths access. IOS and Android. <a href="http://2morrowinc.com/smoking-cessation.php">http://2morrowinc.com/smoking-cessation.php</a></td>
</tr>
</tbody>
</table>
## APPENDIX 10: SKILLS, TRAINING AND COACHING

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| **Food Switch.** Consensus Action on Salt and Health (CASH), the Medical Research Council, Human Nutrition Research, The British Heart Foundation, Health Promotion Research Group, and the Nuffield Department of Population Health and Nuffield Department of Primary Care, University of Oxford, and led by The George Institute for Global Health. (UK) | An app designed to help shoppers switch to healthier food and drink choices. | General public. | • Provides ‘at a glance’ colour coded nutrition information based on a red, amber green “traffic lights” system for over 80,000 products.  
• Allows users to scan the barcode of food and drinks sold across major UK supermarkets using their smartphone camera to receive immediate, easy to understand ‘traffic light’ colour-coded nutritional information along with suggested similar, healthier products.  
• The overall nutritional rating takes into account a range of different factors important to general health including fats, sugars, salt, protein and fibre.  
• Allows users to switch to healthier products based on established nutrition criteria.  
• Health outcome: Potential to improve diet in overweight populations leading to reduction in risk factors for lifestyle related diseases  
• Behavioural Change Intervention: Through information.  
• Winner of the PHE Health X initiative.  
• Developed by leading health experts and supported by 13 organisations as a fee and IMPARTIAL tool to improve the nation’s diet.  
• Cost: App is free to download (UK only).  
• Android/iOS.  
• [http://www.foodswitch.co.uk/](http://www.foodswitch.co.uk/) |
| **RISE.** RISE (USA) | Nutritional coaching system app. | Those needing to lose weight/ improve diet. | • Offers a nutrition coaching system to help users lose weight and make positive lifestyle choices.  
• Users are prompted to take a picture of their food so the coach, a registered dietician, can see what they are eating and provide assistance.  
• The dietician also provides daily feedback and tips to stay healthy.  
• Dietician is matched with client based around common ground e.g. age, sex, parent to create chances of an organic/empathic relationship between the two parties. | • Piloted in summer 2013 RISE launched in Feb 2014.  
• Has gone through a series of updates including the option of integration with Apple HealthKit at the end of 2014. This will allow RISE users to share general health tracking e.g. around activity levels with their RISE nutritionist.  
• Cost: $10 per week.  
• iOS.  
• [https://www.rise.us/](https://www.rise.us/) |
<table>
<thead>
<tr>
<th>Diet/exercise intervention</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **Noom Coach.**  
Noom Inc (USA) | **A weight loss coaching app.** | **Individuals wishing to lose weight.** |
|   | **A coaching app that provides guidance and encouragement to make better health choices contains goal setting, coaching and peer support.** |   |
|   | **According to developers it also integrates with Apple HealthKit in iOS 8 to provide a more accurate picture of calorie burning information.** |   |
|   | **Health outcome:** Potential to reduce weight in overweight populations leading to reduction in risk factors for lifestyle related diseases. |   |
|   | **Behavioural Change Intervention:** Through goal setting and modeling. |   |
|   | **Healthcare professional input required for use?** No. |   |
|   | **Launched:** Sept 2014 Noom Coach is a substantial update from a previous app Noon Weight. |   |
|   | **App is free to download.** |   |
|   | [http://us.noom.com/coach](http://us.noom.com/coach) |   |
|   | **IOS.** |   |

<table>
<thead>
<tr>
<th>Exercise based intervention</th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| **Atari fit app.**  
Atari (USA) | **Personal training and games fitness app.** | **General public.** |
|   | **Provides more than 150 exercises to its users, including custom routines.** |   |
|   | **The app will sit along popular wearable fitness devices and apps, including Fitbit and RunKeeper, as well as the Google Fit platform.** |   |
|   | **Its "motivation mechanism" pushes users to exercise individually or in collaboration with friends, while earning points to unlock classic Atari games, such as Pong, Centipede, Super Breakout and more.** |   |
|   | **Health outcomes:** Potential to change health related behaviour to reduce risk factors for disease. |   |
|   | **Behavioural Change Intervention:** Training, Incentivisation, Education. |   |
|   | **Healthcare professional input required for use?** No. |   |
|   | **Launched:** Mar 2015. |   |
|   | **Android and IOS.** |   |
|   | **Atari Fit also integrates with the Walgreens Balance Rewards, allowing users to earn Balance Rewards loyalty program points for participating in challenges that log steps taken. Points can be redeemed at Walgreens and Walgreens.com.** |   |

|   | **Coach.**  
Cigna (in partnership with Samsung Galaxy) Shealth platform | **An app which creates a holistic lifestyle improvement plan for users based on** |
|   | **General public.** |   |
|   | **Users are asked questions or a range of wellbeing issues such as diet, sleep and exercise.** |   |
|   | **An overall wellbeing score is then calculated with a breakdown of how users score in different areas.** |   |
|   | **Launched:** May 2014. |   |
|   | **Part of the Samsung Galaxy s5 bundle.** |   |
| (US) | their input. | Users can identify what they would like to improve, set personalise health goals and tackle related missions that can be measured and scored using SHealth App’s native fitness tracking data.  
| Health outcomes: Potential to change health related behaviour to reduce risk factors for disease.  
| Behavioural Change Intervention: Training, Incentivisation, Education.  
| Healthcare professional input required for use? No. |

<table>
<thead>
<tr>
<th>Goal setting intervention</th>
</tr>
</thead>
</table>
| **Coach.me.**  
Lift  
(US)  
IOS and Android | To provide personalised coaching in any health goal.  
General public. Anyone wanting to achieve a health related goal. | Users choose a personal goal (coach me supports over 200,000 goals – many of them related to health and fitness)  
The app provides:  
- Advice, which comes from the community of users and coaches.  
- Social networking support through contact with those who share user’s goals.  
- Everyone is available to answer users’ questions, and users can hire (at cost) any of 700 1-on-1 coaches.  
- Motivation by acknowledging progress via the Coach.me community and the Coach.me app which records users’ biggest milestones.  
- Reminders in the form of prompts.  
| Health Outcome: Potential to improve overall health in a variety of ways leading to reduction in risk factors for disease.  
| Behavioural Change Intervention: Environmental restructuring, information and incentivisation.  
| Healthcare professional input required for use? No.  
| Updated Dec 2014. (Previous versions of this app were available prior to this under the name of LIFT but Coach.me is a substantial change to the original app.)  
| Free for IOS and Android devices.  
| Personal coaching sessions command a fee beginning at $15 per week.  
| [https://www.coach.me/](https://www.coach.me/) |

<table>
<thead>
<tr>
<th>Positive mental health interventions</th>
</tr>
</thead>
</table>
| **Buddify App.**  
21 aware  
(UK) | **Meditation app.** | Users develop mindfulness.  
- Behavioural Change Intervention: Environmental restructuring, information and incentivisation.  
- Health outcome: Potential to improve stress levels leading to improved QoL.  
| Healthcare professional input required for use? Yes.  
| Launch: Version 1 launched Jan 2014 (IOS only)  
| Cost: £1.99.  
| The Healthy Mind App | An app to minimise stress and encourage calmness. | General public. | • This app has been designed to establish whether smart phones can sense when the best time for a notification to be sent is.  
• The app will invisibly monitor data such as time of day, physical activity and location of user to decide when to send the notification.  
• The app notifications have been designed using mindfulness theory and CBT techniques.  
• Health outcomes: Potential to improve mental health leading to improved QoL.  
• Behavioural Change Intervention: through training and environmental restructuring.  
• Healthcare professional input required for use? No.  
• Part of an ongoing EPSRC research project.  
• App is free to download.  
• [http://www.healthymindapp.org/](http://www.healthymindapp.org/) |
| --- | --- | --- | --- |
| Stress and Anxiety companion.  
Design and Prosper.  
(UK) | A CBT based app. | General public affected by stress anxiety and depression. | • CBT based app that helps users relax and reduce the physical symptoms of stress and anxiety whilst managing and reframing negative thinking.  
• Comes with “Companion Thought cards” which let uses visual and share key insights with family.  
• Health outcomes: Potential to improved mental health.  
• Behavioural Change Intervention: Education and Training.  
• Healthcare professional input required for use? No.  
• Launched: Sept 2014.  
• IOS.  
• Cost: £3.99.  
• [http://www.designandprosper.com/](http://www.designandprosper.com/) |
| Bliphub.  
Orcas  
(USA) | Self-management app for hypertension and pre-hypertension. | Pre-hypertensive population. | • According to Orcas BlipHub is based on JNC-7114 recommendations along with behavioural change science including habit formation, positive psychology and self-determination theory.  
• Users start with small, easily managed habits that move towards bigger healthy behaviours that promote physical activity, sleep, nutrition, stress and social support.  
• Integrates with accelerometers, blood pressure cuffs, and body weight scales to bring in real-time biometrics. Current devices include FitBit, MisFit, and Withings.  
• Aims for a whole-person approach to addresses both physical health and emotional wellbeing, with a focus on building resilience and new positive habits.  
• Integrated health coaching provides anytime, anywhere access to support and sets triggers for relapse prevention and escalation of care.  
• Launch: Released to the USA market and Turkey in Jan 2014.  
• BlipHub v2 development is already planned and will add new branding, more conditions (stress/resilience, obesity, and diabetes) along with more interactive features, device integration, and health coaching.  
• BlipHub v2 is due to be released Q3 2015.  
• According to Orcas they are actively working with large distribution partners to deliver BlipHub in the USA, Asia, Europe, and Latin America.  
• Mobile Web, IOS, Android.  
• Examples of partners include hospital systems, health plans, electronic health records (EHR), employee assistance programs (EAP), and behavioural health, wellness and disease management providers.  
• ORCAS is currently conducting a 3-arm randomised controlled trial (BlipHub-only group, BlipHub + telephonic health coaching group, and control group) that measures for change in blood pressure and other... |
| **Health Outcomes:** Potential to reduce high blood pressure and associated adverse health outcomes.  
**Behavioural Change Intervention:** Key behavioural strategies include goal setting, barriers resolution, getting support, tracking habits and monitoring biometrics (blood pressure, weight, steps) personalized feedback, monitoring progress, and rewards.  
**Healthcare professional input required for use?** Yes. | health and productivity factors with 210 employed adults. Results available Q3 2015.  
ORCAS sell the software through an annual group license that is metered to covered lives and size of the organization. Customization is available for an additional fee.  
## APPENDIX 11: MHEALTH PLATFORMS

<table>
<thead>
<tr>
<th>Technology &amp; developer details</th>
<th>Function</th>
<th>Patient Group</th>
<th>Description</th>
<th>Further information</th>
</tr>
</thead>
</table>
| Google Fit. Google (USA)      | Activity and calorie tracking platform that plugs into third party wearables and other fitness apps. | General public. | - According to the developer website, Google Fit is an open ecosystem that allows developers to upload fitness data to a central repository where users can access their data from different devices and apps in one location.  
- Users can connect favourite fitness devices and apps to Google Fit and it will aggregate and “surface” the data in a single interface.  
- Compatible with Strava, Withings, Runtastic, Runkeeper and Noom Coach.  
- Goal setting and history tracking are available but main aim of Google Fit is to be the central data store for all fitness data pulled from third party services.  
- **Health Outcomes**: Potential to improve general wellbeing so improve health and reduce major disease risk factors.  
- **Behaviour change intervention**: Education and incentivisation.  
- Users have to grant Google permission to use their fitness data.  
- Cost: Free.  
- [https://developers.google.com/fit/](https://developers.google.com/fit/) |
| OpenTele. Silverbullet (Denmark) | A place to aggregate data across multiple installation’s and 3rd party systems. Can manage single or multiple conditions and clinical inputs in one place. | Could be applied across different patient groups. | - Allows the healthcare provider to create questionnaires which are “pushed” to patients mobile devices to obtain data or provide training/information/prompts.  
- In tandem, patient-generated data obtained using a range of mobile sensors and devices are sent to the healthcare provider who then reviews and takes appropriate action, e.g., teleconference with patient or hospital appointment for patient.  
- Many possible application including prevention programmes.  
- **Health Outcomes**: Potential to improve general wellbeing so improve health and reduce major disease risk factors.  
- **Behaviour change intervention**: Education and incentivisation. | - OpenTele was piloted in May through Aug 2013, and went into live production with patients across Denmark 1/9 2013.  
- Version 2 is in development with sales and marketing support to be in place in Q2 and Q3 2015 with aim to roll out to rest of EU, Canada, UA, Asia and South America  
- Platforms: HL7/PHMR XDS.  
- Medical Device Class 1.  
- Aiming for CE Mark medical device class IIa in Q1 2016.  
- FDA or similar approval aimed for after CE mark.  
- Open Tele has been designated a national platform in Denmark, with funding to roll out to 40,000 COPD patients nation wide. |
```
<table>
<thead>
<tr>
<th><strong>uMotif.</strong> uMotif Digital Health</th>
<th><strong>Health self-management software platform and apps.</strong></th>
<th><strong>Software supports both patients and their clinicians and carers via apps for patients to track, manage and engage with their health and web-portals for clinicians to understand their patients.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Funding has been received from the NHS Small Business research initiative) (UK)</td>
<td>Can be used for a wide range of groups including for Public Health, Primary or Secondary Care.</td>
<td>The tools are based on simple daily self-tracking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The system is configurable to multiple patient groups and each deployment can be configured to suit customer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>uMotif aims to improve health behaviours by:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Increases in medication adherence.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Improvement in patient engagement and empowerment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Enhancing shared decision making.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Health outcomes:</strong> potential to improve health across a range of indicators e.g. BMI, BP, positive mental health reduces risk factors for new disease or worsening of existing conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Behavioural Change Intervention:</strong> through environmental restricting, coercion, education.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Healthcare professional input required for use?</strong> Yes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Obesity intervention</strong></th>
<th><strong>Healthcare professional input required for use?</strong> Yes.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Splendid Platform</strong> SPLENDID consortium comprising 7 partners from across Europe. (Funded by the European Community’s ICT Programme under Grant Agreement No. 610746, 01/10/2013 – 30/09/2016.)</td>
<td><strong>Launch:</strong> Live pilot deployments in the NHS. Planned deployments across UK, Europe, USA and India.</td>
</tr>
<tr>
<td><strong>mHealth platform for overweight and obesity.</strong> Overweight young adults (18-30).</td>
<td><strong>Level 2 Information Governance certification in place.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Cost:</strong> Various models possible including: Fixed annual Software-as-a-Service licences per department / patient group, per patient per month bundled, Software-as-a-Service licences. Value based or payment by results pricing. Value based or payment by results pricing.</td>
</tr>
<tr>
<td></td>
<td><strong>iOS Android and Web.</strong></td>
</tr>
<tr>
<td></td>
<td><strong><a href="https://www.umotif.com">https://www.umotif.com</a></strong></td>
</tr>
</tbody>
</table>

| **Cost:** User fee: 12 euro per patient per year. Transaction fee: 0.07 Euro per measurement. | |
| **http://opentele.silverbullet.dk/** |
| **http://splendid-program.eu/** |
```

and throat area of the user in order to identify chewing. This information will be considered in the algorithms used to calculate the risk for developing obesity or an eating disorder. Information collected with the chewing sensor will be used to guide the person to a healthier eating behaviour.

- **Algorithms:** SPLENDID will be a modular system with multiple sources of behavioural information, analysed in conjunction with the final goal to offer meaningful feedback helping users to normalise their behaviours.
- **Interfaces:** Dedicated smartphone and web-based interfaces will be developed to support both the users and health professional “view” of the platform.
- **Health Outcomes:** Potential to improve general wellbeing so improve health and reduce major disease risk factors.
- **Behaviour change intervention:** Education and incentivisation.
- **Healthcare professional input required for use?** Yes.

| Cafewell. Welltok (USA) | Health optimisation platform. | Can be used to managed specific conditions and/or improve general wellness. | • According to the Welltok website key features of the platform include:
  - Personalized – Generates a tailored set of programs and activities for consumers based on multiple factors.
  - Easy to Integrate – Integrates CaféWell Connect partner programs or existing/preferred client solutions.
  - Expansive - Supports consumers across a continuum from benefit optimization and wellness to condition management.
  - Social – Features group or individual coaching sessions, competition and relevant communities.
  - Dynamic – Highlights a steady stream of relevant content— articles, videos, recipes and more.
  • By combining social, gaming and personalisation the platform aims to encourage health behavioural change.
  • **Health Outcomes:** Potential to improve general wellbeing so improve health and reduce major disease risk factors.
  • **Behaviour change intervention:** Education and incentivisation.
  • **Healthcare professional input required for use?** No. |
| --- | --- | --- | --- |
|  |  |  | • Launched: 2014 with new functionality and updates coming on stream in 2015.
  • [http://welltok.com/](http://welltok.com/) |
Currently applied to pain management but has potential for use on wellness and preventative issues

| Platform for pain management with associated CBT based app. | Tier 1 and Tier 2 patients presenting with pain. Potential for other applications. | The Pain toolkit (PTK) app aims to:  
- Provide a feedback loop between patient and healthcare professional.  
- Improve patient QoL through CBT based techniques.  
- To allow patients to self-monitor.  
- To provide patient information.  
- The Pain Management Plan (PMP) app aims to:  
- Offer techniques to improve quality of life by increasing activity levels, introducing fun and relaxation, and reducing the drug dependency.  
- It includes tension alerts, relaxation resources, medication tracking and the use of games to support engagement, goal-setting and adherence.  
Health Outcomes: Potential to improve wellness and QoL across a number of areas.  
Behavioral change intervention: Through training, education and incentivisation.  
Healthcare professional input required for use? Yes. |
|---|---|---|
Costs: population licence model per year for “managed service” (Integration of PTK App with clinical systems). Pain Management Plan app – separate charge per patient.  
It allows for the integration of standalone apps into pre-existing clinical systems to allow patient self-monitoring to be reported to healthcare providers.  
A patient is prescribed an app via Healthcare provider and provided with an “input token” which creates a patient held record which can integrate into clinical systems and patient entered data can be reported back to healthcare provider.  
IOS /Android.  
http://pain-sense.co.uk |
| General wellness interventions |
| Apple Health Kit. Apple (USA/International) | Wellness platform. | Potential for use across a number of different patient groups.  
HealthKit allows apps that provide health and fitness services to share their data with the new Health app and with each other.  
A user’s health information is stored in a centralized and secure location and the user decides which data should be shared with their app.  
Health Outcomes: Potential to improve wellness and QoL across a number of areas.  
Behavioral change intervention: Through training and environmental restructuring.  
Healthcare professional input required for use? No but can be shared with healthcare providers. |
| | | Launched: June 2014 as part of the Apple IOS 8 release.  
https://developer.apple.com/healthkit/ |
| Track your Health. Wellness & Prevention Inc., A Johnson and Johnson company (US and International) | An app which allows users to incorporate data from third party trackers and sensors, | Has application for general public but currently only available to US health plans.  
Helps users to track daily activities and caloric intake, set goals and visualise progress through detailed charts and graphs designed to help them better understand how to reach fitness targets.  
The app is also compatible with other tracking devices although users without tracking devices can also benefit by simply manually entering their information into the “Track your health” app.  
Health Outcome: Potential to improve health |
| | | Launched: May 2014. The app was released initially for IOS with an Android version being made available in June 2104.  
| **Healthy Target health improvement program.**  
WebMD (US) | **Health platform.** | **Has potential for application across a number of different groups.** |
| --- | --- | --- |
| | | **The Healthy Target app aggregates multiple sets of biometric data from devices such as glucometers, wireless scale and other wearable devices.**  
| | | **It then provides users with an integrated health improvement program that surround their data with WebMD’s content, helping users to set and measure their progress against goals driving behaviour change and improving overall health and wellness.**  
| | | **WebMD have also begun working with companies including Apple, Entra Health Systems, Fitbit, Jawbone, and Withings to integrate health and fitness data into its app.**  
| | | **Behavioural Change Intervention: Incentivisation, goal setting and information.**  
| | | **Health Outcome: Potential to improve wellness and QoL across a number of areas.**  
| | | **Healthcare professional input required for use? No.**  
| | | **Released June 2014.**  
| | | **Cost:** Free.  
| | | **iOS.**  
| | | [http://www.webmd.com/webmdapp](http://www.webmd.com/webmdapp) |

| **Balance Rewards for healthy choices.**  
WebMD and Walgreens (US) | **Health monitoring platform that contains a rewards point scheme that gives users points for staying well.** | **Wallgreens balance reward club members only.** |
| --- | --- | --- |
| | | **Balance Rewards can give users points to spend at Walgreens for healthy activities such as walking, running, cycling, weight management, sleep or nicotine replacement therapy.**  
| | | **Users can log personal wellness goals, track progress, earn badges and connect with the Balance Rewards community to stay motivated.**  
| | | **Users can sync with leading fitness and health devices & apps to track activity and earn points automatically.**  
| | | **Health outcome: Potential to lead to better overall health thus reducing disease risk factors.**  
| | | **Behavioural Change Intervention: Incentivisation, goal setting and information.**  
| | | **Healthcare professional input required for use? No.**  
| | | **Launched July 2014.**  
| | | **Press release:** [http://walgreens.isebox.net/brhc/walgreens](http://walgreens.isebox.net/brhc/walgreens)  
| | | **Cost:** Free to Walgreens customers.  
| | | **IOS and Android.**  
| | | [https://www.walgreens.com/steps/stepslanding.jsp](https://www.walgreens.com/steps/stepslanding.jsp) |
## Technology & developer details | Function | Patient Group | Description | Further information
--- | --- | --- | --- | ---
**Physical activity interventions**

### FeeFiFoFit.
*Citrus Suite* (UK)

**Gamification of exercise app.**

Families wishing to increase exercise levels.

- An immersive fitness game designed by Citrus Suite to help young families get active.
- Player’s real life movements are tracked and fed back to characters within the app.
- As the user becomes more fit so does their character. Includes trophy cabinet, collectables and a competitive element so that users can play against other users and family members.
- **Health Outcome:** Potential to improve general fitness leading to improved quality of life and reduction in lifestyle related diseases risk factors.
- **Behavioural Change intervention:** through incentivisation.
- **Healthcare professional input required for use?** No.

- Launch: The app is currently in production and trials are under way.
- Citrus suite won Health X award from Public Health England.
- The app will be part of the Change for Life campaign.
- Cost: free to public.

### Get on Up.
*Geton Up* (UK)

**App to gamify activity through music.**

General public.

- Creates personalised music that matches users’ movements and tells them how active they have been throughout the day (and provides details on friends activity levels). Designed to improve general fitness levels.
- **Health Outcome:** Potential to improve general wellness leading to improved quality of life and reduction in lifestyle related diseases risk factors.
- **Behavioural Change intervention:** through incentivisation/Coercion.
- **Healthcare professional input required for use?** No.

- Launched: Beta testing.
- Free to use but will offer ‘premium music packs’ for monthly fee.
- Android and IOS.
### Alcohol consumption reduction interventions

| **Chimp Shop.**  
Attention Retraining Technologies Ltd (Bangor University Spinout company) (UK) | **Gamification to alter attentional bias to help reduce alcohol consumption app.** | **Those wishing to reduce their alcohol consumption.** | **Launched:** End of 2014.  
**Original research the app is based on:** Fadardi, J.S., Cox, W.M., Reversing the sequence: Reducing alcohol consumption by overcoming alcohol attentional bias. Drug and Alcohol Dependence 2009;101(3):137-45.  
**Cost:** 69p or 99p depending on the operating system. Also to be distributed by healthcare providers who can then issue codes to suitable patients for free downloads of the app.  
**Android and IOS.**  
- Aims to wean heavy drinkers away from alcohol via observations made at the university on the way the brain responds to external stimuli.  
- Subjects with an inclination towards consuming alcohol will take fractionally more time viewing and assimilating pictures of beer cans or wine bottles than they will when they see images of non-alcoholic goods.  
- This app aims to overcome the bias towards one set of stimuli and redirect the user’s appetites towards more constructive activities.  
- In the ChimpShop game players rush down the aisles of a supermarket that has been occupied by malevolent chimps who are hurling goods into the path of shoppers. The aim of the game is to intercept as many flying objects as possible.  
- The catch for people with a leaning towards alcohol addiction is that their inbuilt bias will cause them to pay too much attention to drink products, thus slowing down their responses and reducing their overall score.  
- They can only progress through the game by directing their attention to the healthier alternatives being thrown by the anarchic primates. As they improve their score, the players’ brains are retrained to abandon their alcohol attention bias.  
- **Health Outcome:** Potential to improve general wellness leading to improved quality of life and reduction in alcohol related diseases risk factors.  
- **Behavioural Change intervention:** through incentivisation and training.  
- **Healthcare professional input required for use?** No. |  
- Potential application across a wide range of preventative issues  
| **Oculus Rift.**  
Oculus (USA)  
Acquired by Facebook in 2014 | **Virtual reality headset.**  
Currently not marketed for health but has potential for health application. | **It uses a combination of 3-axis gyros, accelerometers, and magnetometers, which make it capable of absolute (relative to earth) head orientation tracking without drift.**  
**The Institute for Creative Technologies (ICT) at University of Southern California has used**  
- **Launch:** Developer versions for sale at a price of $350.00 via website at: [https://developer.oculus.com/](https://developer.oculus.com/). Consumer version to be released sometime in 2015.  
- **See YouTube video:** Oculus Rift - Interview with Palmer Luckey at Games for Health |
the Oculus Rift for post-traumatic stress disorder treatment.
- **Health Outcome**: Potential to use to improve general wellness leading to improved quality of life and reduction in lifestyle related diseases risk factors
- **Behavioural Change intervention**: through Incentivisation/Coercion.
- **Healthcare professional input required for use?** No.

[Accessed August 2015.](https://www.youtube.com/watch?v=DaMDUMtToVUQ)

There are also several well-known manufacturers (e.g. Samsung, Sony and HTC) who either wish to use Oculus technology to produce their own versions or are launching competitor products based around similar tech.

[https://www.oculus.com/](https://www.oculus.com/)
REFERENCES


http://shop.bsigroup.com/upload/271432/PAS%20277%20282015%20bookmarked.pdf


21 Substituteable Medical Applications, Reusable Technologies Health IT. SMART Platforms. 

http://rockhealth.com/2015/01/digital-health-funding-tops-4-1b-2014-year-review/


24 The Government Office for Science. The Internet of Things; Making the most of the second digital revolution. December 2014. 


http://www.england.nhs.uk/ourwork/futurenhs/


33 Innovate UK. Wearable Technologies Innovation Contest. 


35 National Health Service England. NHS Nursing technology fund. 


37 Imperial College London. Sustainable Society Network+: Research Themes. 


106


91 Klein, M., Mogles, N. and van Wissen, A. Intelligent mobile support for therapy adherence and behavior change. Journal of Biomedical Informatics; 2014; 51,137–151


94 Johns Hopkins Bloomberg School of Public Health. mHealth-Can you hear me now. Special Issue 2012. http://magazine.jhsph.edu/2012/technology/features/mHealth/page_5/


