Section 1: Introduction

This document contains examples of healthcare apps in the form of case studies. The apps are all currently in use within the NHS and many have received innovation related awards for their developers. These examples have been provided to illustrate the range of approaches taken by developers of apps currently in use in the NHS. They are not intended as gold standard examples of the ideal approach to evidence generation.

Interviews were conducted with their developers or team members to gain an insight into the development and adoption of the app, evidence gathered to date on relative efficacy, safety and resource use, future plans for evidence generation, and any lessons learned along the way.

The healthcare apps identified include:

• Big White Wall – an app and web-based support service for people with mental health needs;
• ChatHealth – a safe and secure two way messaging system that puts people in touch with healthcare professionals. Current use is mainly by students at school communicating with school nurses;
• GDM-health – an app enabling monitoring and management of blood glucose levels, and communication between pregnant women with gestational diabetes mellitus and health care providers;
• Mersey Burns – an app which calculates total burn surface area and volume of resuscitation fluids needed for burns patients to enable clinicians to appropriately assess and manage burns injuries;
• OWise – a website and mobile app that allows breast cancer patients to assemble all of their information regarding their breast cancer treatment in one place giving them a clear visual overview;
• Brush DJ – an app that aims to encourage tooth brushing for an effective length of time using music and other behaviour change techniques;
• Sleepio – a digital sleep improvement program that aims to improve sleep problems using Cognitive Behavioural Therapy techniques;
• True Colours – an online self-management system that enables a patient to monitor symptoms and experiences using text, email and internet using patient questionnaires. It is currently used in a range of patients, particularly those with bipolar disorder;
• Myhomehelper – a memory aid with the aim of assisting those living with dementia or learning difficulties;
• SilverCloud – internet delivered online cognitive behavioural therapy programmes for a range of mental and behavioural issues which can be access through a website or mobile app.
Case Study with Big White Wall

Developer: Jen Hyatt and Big White Wall Team

DESCRIPTION OF THE APP

Big White Wall (BWW) is a web-based support and recovery service for people aged 16 plus, with mental health needs who are anxious, low or not coping. The service is online which can be accessed using an iOS or Android app, or via its website. An online community support each other with guidance from trained professionals who are online 24/7. Users access the service anonymously in a safe and facilitated environment. Other features include offering personalised suggestions to enhance recovery, access to on-line courses using recognised therapies, creative arts and writing therapies and related articles and use of tools to set goals and track progress. Live Therapy also enables users to receive CBT or counselling using audio, video conferencing or live text. BWW also provides a pathway to help users determine, through self help and peer support, if further therapeutic or other support is needed.

Benefits of the 24/7 service for users, include providing them with another option to get help when needed and when many services are not available. The NHS could potentially benefit from reduced strain on services such as Accident & Emergency and out of hours. Its anonymity allows users to discuss issues more easily, with many users sharing issues that they had never previously shared. Individuals can join BWW for £24 per month.

EVIDENCE

Evidence to Date

At launch, published research evidencing the effectiveness of peer support, web based help and internet psychotherapy helped to establish an evidence base of clinical efficacy, however none of these studies used BWW as their intervention.

An independently-led evaluation of BWW was conducted in late 2008 which collected evidence from a survey of members, with 229 of 598 (38%) members responding. The results showed that the most significant benefits to users were self-understanding, reduced isolation, feeling less depressed or stressed, gain in confidence and reduced anxiety. The majority of members were able to self-manage their mental wellbeing without recourse to further help.

Results from a further survey of BWW members from NHS, local government and employer contracts in 2015 informed a estimate of the net savings from avoided NHS interventions, reporting a cost benefit ratio of 1:3.8. BWW also uses its own data to measure usage and well-being outcomes and these can provide powerful indicators of impact on users.

These, along with the emergent clinical studies and anecdotal evidence from members, provide current evidence for the system.

Evidence going forward

BWW researchers note the rapid pace of service adoption is not easy to reconcile with the timescales of academic trials, such as randomised controlled trials (RCTs). However, studies of effectiveness are needed to foster innovation and efficacy. BWW is the subject of 2 RCTs which are currently underway. The first is examining the support network as a self referral intervention and is being conducted by Institute of Mental Health, University of Nottingham. The second is examining the Live Therapy aspect and is being conducted at the Centre for Outcomes Research & Effectiveness, University College London. BWW is also working with the East Midlands AHSN on an 18 month observational study and evaluation of the Support Network and Live Therapy in Derbyshire and with a large employer in the USA to measure benefits from that perspective.

LESIONS LEARNED

- Clinical studies showing efficacy for the interventions plus results from a well-conducted independent evaluation were sufficient evidence for early adopters of BWW, although growth was initially quite slow due to slow adoption in general of digital technology within the NHS;
- Clinical studies of similar interventions are useful in demonstrating efficacy at launch, however RCTs or other suitable study types may be needed once app is mature;
- Partnerships with NHS Trusts, AHSNs and universities can provide support to conduct independent trials to generate evidence;
- The product must be constantly developed through user feedback and internal evaluation.

REFERENCES

Case Study with GDm-health

Developers: Oxford University Hospitals NHS Foundation Trust, Institute of Biomedical Engineering, University of Oxford Department of Primary Care Health Sciences, University of Oxford. Oxford UK.

DESCRIPTION OF THE APP

GDm-health is a Android smart phone app enabling monitoring, management and communication between pregnant women with gestational diabetes mellitus and health care providers. About 10% of pregnant women develop gestational diabetes and the figures is rising. The system comprises of the app, with a bluetooth-enabled blood glucose meter, which the patient uses; and a secure website, with optimised data presentation and alerting algorithms. The website enables healthcare professionals to manage patients in real time by text messages and communicate with other staff involved in their care. The app enables women to receive feedback on glucose levels and alter diet accordingly. Engagement is encouraged e.g. women can ‘tag’ their readings with details on meal timings and use a reminder function to encourage compliance.

Standard clinical practice is for these women to record their blood glucose levels up to six times a day, with their medication adjusted at fortnightly check ups. Advantages of the app include the software prioritises patients for review by midwives and health care professionals and enables them to observe the effects of medication adjustments as they occur, without waiting for the next clinic visit. Woman avoid the stress and expenses, in terms of time and money, attending outpatient clinics and potentially improve their health and that of the baby. The NHS can operate a more efficient service which directs care to those who need it most, and accommodate increasing demand.

Figure 1: Graph showing medication adjustments

Pre-lunch medication and post-lunch blood glucose

Development Process

The idea for GDm-health was in response to the increasing prevalence of gestational diabetes, and the associated increase in workload. It was developed in collaboration between Oxford University Hospitals NHS Trust and the Institute of Biomedical Engineering of the University of Oxford. A team was formed with members from clinical stakeholders, women and engineers, and weekly meetings were held to agree the specification and develop a test-bed website using existing clinical decision rules. The website was developed in a few months and then beta tested to identify any major bugs or issues.

Safety

A custom built secure website was developed to ensure data confidentiality. Several features of the app are designed to improve the safety of monitoring. For example, the use of Bluetooth to upload data instead of entering it manually reduces possibility of errors that may occur when women type in their own readings. Readings also cannot be deleted, however comments can be used to explain high readings. Communication with the healthcare team is improved, and women can request a callback specifying the level of urgency by requesting a call within 3 days or 24 hours. There are optional alerts to remind women to perform the blood glucose reading after their meals reducing the possibility of missed readings. There are also alerts for the clinical team to help highlight women who require intervention. The alerts are for high or low readings and set to identify specific patterns, for example consecutive high readings after a particular meal give a red alert. Alerts also show when a woman is not submitting the recommended number of readings in a week.

Adoption

The system has been implemented at several other trusts including Royal Berkshire NHS Foundation Trust, Milton Keynes University Hospitals and Frimley Health Hospitals, however there have been some challenges to scaling up. For example providing ongoing technical support. GDm-health was also awarded the Quality in Care Diabetes award for best digital initiative in 2014.

EVIDENCE

Evidence to Date

Beta testing of the app was conducted with seven women and midwives to resolve technical issues and respond to user’s feedback. 1, 2 Thereafter, a service development project recruited 52 women to use the GDm-health system to monitor blood glucose and to adjust medication without paper-based monitoring, for an average of 13 weeks. Ethical approval was not required because this was a service development project where diabetes care was not changed. Questionnaires completed by the women measured general satisfaction, equipment issues and relationship with the diabetes care team. Analysis of system usage was positive, showing that the GDm-health app is acceptable and convenient for a large proportion of women. 1, 2 Functionality was optimised using feedback from these users.

The next phase was to evaluate clinical, economic and satisfaction outcomes in a randomised controlled pilot trial (RCT). This recruited 200 women, 100 of whom received standard care and 100 received remote blood glucose monitoring with GDm-health and half the normal clinic visits. The primary endpoint was glycaemic control, with secondary endpoints including economic and patient metrics such as attendances at clinics, travel time and time off work. Analysis of the results is underway and are yet to be published. 3

The app has also been implemented at 4 trusts with quantitative usage measures such as number of blood glucose measures transmitted, mean readings per woman per week, clinic attendances, and midwife admin time, and qualitative measures such as woman and clinician satisfaction recorded to provide real world data.

Evidence going forward

The RCT and real world data have informed planning for a second, multi-centre, RCT which will evaluate clinical effectiveness and impact on resource use. It will take approximately 3 years to conduct and will also evaluate clinical outcomes.

The developers also modelled how to scale-up usage of the app. This is updated as lessons are learned from implementation and adoption across new sites. Other developments include enabling the app to run on an iOS platform and a woman’s own handset.

Figure 2: Infographic of GDm monitoring system

LESSONS LEARNED

• Having a multidisciplinary team and involving the target audience at every stage of the process has been very important to building a safe, robust and user friendly system.
• Having relatively small trials has proven safety and efficiency of the app-led service but larger trials are needed to demonstrate clinical and cost-effectiveness.
• Scaling up has been challenging, but has benefited from access to initiatives and network expertise such as the AHSN.
• Key to success has been the weekly focus group of clinicians, patients and engineers which ensures collaboration across communities, disciplines and organisations.

REFERENCES

Case Study with Mersey Burns

Developers: Medicapps - Rowan Pritchard Jones, Chris Seaton, and Paul McArthur
St Helens & Knowsley Teaching Hospitals NHS Trust

DESCRIPTION OF THE APP

Mersey Burns is a free clinical tool which runs on an iPad, iPhone, iPod touch, Android, Blackberry, Playbook and HTML5 compatible browsers. It is accompanied by a manual which is downloaded with the app. It provides physicians with a tool to calculate total burn surface area (TBSA) and the volume of resuscitation fluids needed. Appropriate burn injury assessment and management is critical to ensure the best outcomes for patients.

Its use replaces traditional paper chart and calculator methods for estimating TBSA and calculating fluid requirements. These require 19 separate calculations, giving rise to a potential for error and thus patient harm. Information can also be easily shared with a local Burns Unit to confirm management of the patient prior to transfer and allow preparations at the Burns Unit to receive the patient.

It can be used in any setting but may be particularly useful in acute care such as emergency departments to guide early management of burns by non-burns specialists. The Mersey Burns Tool has been awarded an NHS Innovation award and was the first UK health app to carry the CE mark from the Medicines and Healthcare products Regulatory Agency.

Figure 1: Screenshots of Mersey Burns

Development process

Working in a regional burns unit and recognising the problem of burn patients arriving in poor condition after receiving inappropriate resuscitation gave rise to the idea of Mersey Burns. The primary developer, Rowan Pritchard, a Plastic reconstructive surgeon, worked with a computer scientist to build the app in just a few weeks. The tool was shared with several clinicians to get feedback on factors such as usability, technical performance and design features including use of the touch orientated screen to shade the burn. Enhancements were made over a relatively short period.

Safety of the app in use

Validation occurs every time the app is opened by running 5,000 test cases and comparing them to stored test case solutions. If there is a difference between the results the app will not run which avoids risk to patient safety with incorrect calculations. This also helps to mitigate against changes arising from platform updates which might affect how the app runs.

No patient data is held on the app, and if clinicians choose to send patient details via the app to a regional burns unit, they are reminded of Information Governance requirements before the email is sent.

Adoption

The App has been implemented across several Trusts including Merseyside and Oxford and the Midlands Burns Operational Delivery Network. Factors conducive to widespread adoption include: publication of statistically significant results from a randomised trial in the Emerging Medicine Journal, CE marking, word of mouth, publicity from winning Health Innovation and Education Cluster grant, eHealth Insider award and NHS Innovation award plus that it is free and runs on smartphones which most potential users already own.

REFERENCES


EVIDENCE

Evidence to date

The developers judged providing evidence of the safety and non-inferiority of the app was essential particularly when used by clinicians not experienced in managing people with burns. Two studies were undertaken4.

A pilot study aimed to compare the accuracy and variability of calculations made using the app or paper (current practice). It recruited 20 clinicians (10 specialist trainees and consultants from plastic surgery and 10 from emergency departments) who were shown a photograph of a child with a burn injury and asked to calculate the TBSA, and devise a fluid resuscitation and maintenance fluid protocol. A calculator and a Lund and Browder paper chart to estimate TBSA were provided. Four of the 10 staff from plastic surgery assessed the same burn using the app.

The results showed no significant differences in the TBSA or total fluid requirements calculated using the Mersey Burns app or the paper method. However, there was a significant reduction in the between-subject variance for fluid calculations with the app. Moreover, several clinicians (9/20: 45%) were unable to attempt a calculation of background fluid requirements in children using the paper method.

The second study was informed by the pilot and sought to remove variation in staff experience and hence recruited 42 senior undergraduate medical students with no experience of burns management. They received a 1 hour lecture on burns management and fluid resuscitation involving demonstrations of the standard paper method and the app. They were asked to assess a prosthetic simulation of a mixed depth burn injury. All participants were randomised to use either the app or paper method first and then cross-over to the second method. They were timed to completion of calculations. Participants also completed a questionnaire assessing 7 usability criteria. Results showed the accuracy of the calculations using the app were 100% correct and between 62-81% correct using the paper method. Further the participants found the app easier to use and it was significantly quicker than the paper system.

An independent study evaluated the accuracy and speed of the Mersey Burns app compared to a another app and a paper system. The results from 34 participants of various clinical grades and specialties showed no significant difference in the incidence or magnitude of errors, or usability across the methods, both apps were significantly faster to use than the paper method.2

NICE has published a Medtech Innovation Briefing on Mersey Burns which provides an overview of the app, its evidence base and likely place in therapy.3

Evidence going forward

The app is currently in use at Alder Hey Children’s Hospital where clinicians are auditing the patients being managed by the App; the audit results will provide real world patient data on outcomes with the app. No further clinical studies are planned.

Figure 2: Burn area calculation

LESSONS LEARNED

• A well-designed randomised study, informed by a results from a pilot study provided sufficient evidence of equivalence; evidence of clinical end points was not required. This enabled fairly rapid market entry and reduced costs.
• Safety concerns now focus on issues with the platform not the app.
• Despite proven effectiveness and safety, and the fact that the app is free it can still be difficult to implement into Trusts due to clinical resistance, suggesting it is difficult to change healthcare practice.
Case Study with True Colours

Developers: True Colours Team, University of Oxford, Department of Psychiatry, University of Oxford

DESCRIPTION OF TRUE COLOURS

True Colours is an online self-management system that enables a patient to monitor symptoms and experiences using text, email and internet. Through the use of patient questionnaires a record is created of the patient’s feelings and how these change over time. The record can be annotated to note items such as changes in medication or environmental stressors. This information can be used by the patient to monitor their own health and shared with family or a care team. It is also available to the consulting physician. It is particularly useful for patients with disorders such as bipolar, but can be tailored for use in other areas where patients must recall events such as chronic headaches or gastrointestinal disorders.

Validated clinical questionnaires are used or the patient can develop a personalised questionnaire, choosing up to three daily and three weekly questions. Multiple questionnaires can be answered to allow patients to track potential correlations, for example how much alcohol they are drinking and their mania score.

The True Colours system is automated to send messages at a specific date and time of the patient’s choosing to remind them to return their responses. These are calculated to give a total score and plotted onto the patient’s graph for viewing online.

True Colours encourages self-management by empowering patients to better understand how factors such as sleep, alcohol or medicines affect them; they can also identify when their health is worsening and act quickly to prevent progression. Healthcare professionals benefit from having a comprehensive picture of a patient’s health. This enables them to prioritize patients to be seen in clinics, rather than relying on routine appointments. Real-time self-reported data avoids recall bias and enables a more effective consultation with the patient, providing a higher standard of care.

True Colours can also be used for research purposes as it enables patient reported outcomes and biometric data to be collected easily and efficiently. Questionnaires are tailored to the intervention, reminders improve compliance and analysis is facilitated using existing software.

Figure 1: Example Mood Graph

Development Process

The clinical need behind the idea for True Colours was the requirement for an accurate way for patients with bipolar disorder to measure their mood fluctuations. Recalling moods in the months preceding a clinic is challenging, often highly subjective and open to bias, for example people tend to remember particularly high or low moments. The concept was to develop a system which allowed patients to measure and record their mood, and also allowed remote monitoring by clinicians.

The technology was first developed in the Department of Psychiatry, University of Oxford in 2007. It was awarded the NHS Live Award in 2008, and the increased demand for the system led to a collaboration between the Department of Psychiatry and the Department of Computer Science to further develop the system, which was named ‘True Colours’.

The Oxford Trust has been supportive in the development process by funding research assistants and a manager to facilitate the help facility and manage the system. Research grants have also been awarded by NIHR and the Welcome Trust.

Safety

Patients and clinicians receive extensive induction and training when they start using the True Colours system. There is also a help facility staffed by clinical research assistants who should have difficulties accessing the system, or if a patient is worried. A traffic light system is in development to alert clinicians if a patient’s health is significantly deteriorating.

Adoption

The True Colours system has been increasingly used as an outcome measure in clinical trials and studies and in clinical practice. Now over 2,000 patients use it routinely. However clinical adoption has been relatively slow because adoption requires service transformation; it cannot be dropped into an existing service without material changes to the mode of delivery of patient-centered care. Significant training is also required, and the Trust must provide staff to manage the system including help facilities.

EVIDENCE

Evidence to Date

A qualitative study was conducted in order to gain feedback on user experience. Indeed feedback from patients and clinicians has constantly informed the development of the app and it is only now after 10 years of development that the version in use is sufficiently mature that the team would consider undertaking a randomised controlled trial (RCT). Ideally this would measure relative effectiveness and change in resource use and hence inform an economic evaluation.

True Colours has been used in a number of research studies as a data collection tool to gather data on patient outcomes. For example the app was used to collect outcome data from participants in a nationwide clinical trial. Outcomes measured included the Quick Inventory of Depressive Symptomatology (QIDS-SR16) questionnaire, Altman Self Rating Mania Scale (ASRM) questionnaire, and EQ-5D-3L quality of life questionnaire. 1

The True Colours system was also used in a study to develop a psychoeducational treatment for patients with bipolar disorder. Participants were asked to complete daily questionnaires regarding their mood and sleep and the QIDS and ASRM questionnaires. 2

True Colours is also being used for outcome measurement in the NIHR funded programme OXTENT.

Evidence going forward

A pilot trial of the True Colours system is currently being drawn up which will precede an RCT set in both primary and secondary care. Pragmatic or experimental RCTs may be conducted in the future in specific clinical areas such as bipolar disorder or headaches.

Figure 2: Example Questionnaire

LESSONS LEARNED

• Digital apps can benefit research and not just patients or healthcare professionals, by being used as a data collection tools in clinical trials;
• The data collected can be analysed to look for trends and break points which can inform algorithms which are efficient in detecting when clinical interventions are required;
• Anecdotal evidence and a qualitative study were sufficient for adoption with some clinicians and patients, but RCTs and economic evaluation are needed later on to encourage further adoption within other Trusts;
• Major barrier to adoption was service changes required by Trusts, not lack of evidence.

REFERENCES

Case Study with OWise breast cancer

Developers: Px HealthCare

DESCRIPTION OF THE APP

OWise breast cancer is a website and mobile app that allows breast cancer patients to assemble all of their information regarding their breast cancer treatment in one place and gives a clear visual overview. It can help patients feel more informed and in control of their treatment by allowing them to collect data on their treatment experiences, side affects, mood, symptoms, treatment plan, appointments, and questions for their doctor. The app also offers tips on issues to discuss with the healthcare team and can help patients to decide what treatment is best for them. Trends of symptoms and emotional state are displayed on graphs and can be shared with clinicians. Doctors appointments can be audio recorded and shared with family members, and a list of questions and answers can also be stored to allow patients to collect the most important to them. The app is free to download and can be used on iOS or android platforms and via the OWise website.

Clinicians can use the data collected to inform decision-making about treatment options which supports a personalised treatment approach. Features such as symptom tracking can allow clinicians to view how their patients are responding to medication and adjust the treatment if and when necessary. Further, it can support the relationship between patient and clinician and improve dialogue leading to more effective appointments.

In addition to the benefits that the app can provide to patients and clinicians, the fully anonymised user data can be used for medical research to improve the outcome of treatments for breast cancer in general. It is planned that data on side effects, outcomes, and interactions and correlations between different treatments will be extracted and shared with hospitals, academic research centres or pharmaceutical companies for use in medical research.

Figure 1: Screenshots of OWise app

Development process

The development of OWise was initiated by medical researcher Dr Anne Bruinvels, and was based on her desire to improve the outcomes of breast cancer treatment, whilst supporting patients during their treatment. The app was co-created with 12 patients who were interviewed on a one to one basis to understand their needs, and this group continued to provide advice on the app throughout development. Shortly after these initial meetings, the company sent out a questionnaires, and received between 200 to 300 responses, which informed users’ requirements. The app was built in 7-8 months and then underwent rigorous testing with 50 clinicians and 150 patients for a 6 month period. It was under development for approximately 2 years before being released in 2013 in the Netherlands. The app was awarded a CE mark in 2014 after providing evidence of software developments, internal quality control, IT documentation, and data privacy. The company is continually developing the app to incorporate feedback from users.

Safety of the app in use

Safety of patient data was a key consideration when developing the app, and the developers made sure that the app was compliant with the Health Insurance Portability and Accountability Act (HIPAA). No personally identifiable data are embedded into the app and email addresses used to sign in are one-way encrypted. A non profit public benefit foundation, the Px for Life Foundation, was established to manage and protect user data. User data is fully anonymised for medical research purposes and is treated in accordance with the most recent privacy protection regulations as required by the UK Data Protection Act (1998).

The company responds to queries from users within 24 to 48 hours. It will not provide medical advice, but rather signposts users to evidence collated from reputable sources such as National Institute for Health and Care Excellence.

Adoption

The app was originally launched in the Netherlands in 2013. It was the winner of the Dutch Health App Award 2013, and voted the most innovative European digital health company in the J&J Digital health challenge 2013. Following this success Dr Anne Bruinvels was awarded a Fellowship by the NHS Innovation Accelerator to support the roll out of the app across the NHS, and the app was released in the UK in February 2016.

EVIDENCE

Evidence to date

A qualitative evaluation was conducted to explore patients’ and clinicians’ experiences using the app during diagnosis and treatment, with the aim of better understanding potential benefits in clinical practice. A secondary aim was to evaluate the potential to use self-reported app data for research purposes. Between June 2013 – April 2014 breast cancer patients were invited shortly after diagnosis to use the OWise app and were followed up for a period of 6 months. 15 patients aged between 30-63 participated, and in depth interviews were conducted regularly with them and their medical team (n=10). Overall results showed positive experiences among patients and the medical team. The majority of patients and medical professionals found the app useful and would recommend it to others. 1, 2

In order to develop a UK tailored product, the company undertook a 3 month testing period involving several oncologists and clinical nurse specialists, to assess the use of OWise in the UK. Studies involving individual patients and focus groups are on-going in collaboration with Maggie’s Cancer Centres.

Evidence going forward

Plans of how to develop the evidence base for OWise are still underway. The company is intending to do a quantitative study using real world data, but cannot conduct a randomised controlled trial because product is evolving and in the Netherlands a placebo would not be ethical as the app is so widely used. The company is still considering how to develop an evidence base to demonstrate effectiveness across broader audiences in the UK and US.

There are also plans to expand the application of OWise to prostate, lung and colon cancer, in addition to developing an exercise app for women with breast cancer.

Figure 2: Screenshots of Trends

LESSONS LEARNED

- Essential to adopt an evidence-based perspective from the start of the process;
- Early product development is best informed by extensive research into user requirements;
- Continued enhancements based on feedback from all users has resulted in a patient-centred app;
- Partnership with clinical teams is essential for safe and effective use;
- Good paper and digital trails of software developments and internal quality control was essential to qualify for CE marking.

REFERENCES


Figure 3: Screenshots of Screenshots of OWise app
Case Study with Brush DJ

Developer: Ben Underwood

Description of the app

Brush DJ is a free app that plays two minutes of music taken from the user’s device, cloud or music streaming service, to encourage brushing for an effective length of time. The app allows users to set a reminder to brush twice a day, use a fluoride mouthrinse at a different time of day to toothbrushing and when their next dental appointment is scheduled. Recognised behaviour change techniques are used to motivate users to adopt an effective oral hygiene routine. These include prompts and rewards as well as instructions on how to perform oral hygiene activities using animated videos.

The app provides evidence-based, age-specific information in accordance with the Public Health England (PHE) toolkit ‘Delivering Better Oral Health’. The app also has hyperlinks to NHS Smokefree, NHS Choices Alcohol and Healthy Eating websites. Links to animated videos published on YouTube showing how to effectively use a manual toothbrush, floss and interdental brushes are also provided through the app.

The Brush DJ app is intended as a motivational tool to help increase frequency and length of brushing, which has been shown to increase plaque removal and reduce the risk of plaque-associated diseases.

Figure 1: Screenshots from the Brush DJ

[Images of screenshots]

Development process

Being a dentist, the developer recognised the need to motivate people, particularly children, to brush their teeth at least twice a day for 2 minutes. Having no app coding skills, the developer outsourced the build of the app to a software development company. The developer found tools such as the The Online Testing Criteria Tool from the App Quality Alliance, a non-profit-making self-help group, very useful. The app was launched in the Apple App Store in 2011, and in the Android app store in 2012.

Initially, feedback was requested from the developers friends, family and patients. Formal opinion was provided by the Dental Defense Union, Public Health England and the Chief Dental Officer for England. Since launch constant feedback has been received from users, which is continually reviewed and informs further development of the app.

Safety of the app in use

The app is very low risk in terms of safety, with all information given to users identical to that given by PHE. The app does not collect any personal information from users, so there are no issues of the app leaking personal health data. All reminders are generated by the app and are not stored outside the users device.

A new Android version of the app has recently been released with an new iOS version to follow in early June 2016. The developer is exploring whether the Brush DJ app should be CE-marked as a medical device.

Adoption

By February 2015 the app had been downloaded on to over 155,000 devices and by April 2016 this figure had risen to just under ¼ of a million downloads in 193 countries. A number of local authorities (LAs) already promote the app and the developer is working with other LAs, NHS England and PHE to encourage wider adoption. The developer was selected as one of the inaugural NHS Innovation Accelerator Fellows in 2015 and was the AXA PPP Healthcare Tech & You ‘Keep Me Healthy’ category winner in the same year.

Evidence

Evidence to date

A cross-sectional qualitative user perception questionnaire has been carried out with the results published in the British Dental Journal in 2015. The survey questions were piloted before being released and ethical approval was not required as the participants in the survey were not randomised to different groups, the study did not demand changing treatment or patient care from accepted standards and the findings cannot be generalised.

The questionnaire consisted of 9 multiple choice questions with space to give further details if none of the options were suitable and one open-ended question. The invitation to participate in a Survey Monkey questionnaire was via a pop-up notification, which appeared when the app was opened at least three times. There was an option to not participate or to respond at a later date. Between October 2014 and January 2015, 189 people responded to the questionnaire. Seventy percent (n=131) of respondents reported that their teeth felt cleaner since using the app. Eighty-eight percent (n=133) reported the app motivated them to brush their teeth for longer and 92.3% would recommend the app to their friends and family. Qualitative responses were analysed using thematic analysis. Four broad themes relating to how the app helped toothbrushing were reported. These themes were motivation, education, compliance and perceived benefits. The paper concluded that a mobile app is a promising tool to motivate an evidence-based oral hygiene routine.

The survey is still running and to-date has received over 1,000 responses, which continue to inform development of the app.

Evidence going forward

The potential to conduct a cluster-randomised controlled trial to assess the clinical and cost effectiveness of the app is being explored. The developer is keen for this to be carried out in multiple countries as the new version of the app is translated in to 13 languages.

Figure 2: Screenshots showing guidance

[Images of screenshots]

Lessons learned

• Ensuring the app remains user friendly is vital throughout development.
• Use of established testing criteria by organisations such as the App Quality Alliance is helpful.
• Using an online questionnaire enabled large amounts of information to be gathered in a relatively short time period and in a cost effective manner.
• Keeping respondents anonymous during the questionnaire study meant recruitment could be undertaken from current users of the app.

References

Case Study with ChatHealth

Developers: Jimmy Endicott, Leicestershire Partnership NHS Trust

### DESCRIPTION OF THE APP

ChatHealth is a safe and secure two-way messaging system that puts people in touch with healthcare professionals. Currently its main use is enabling pupils aged 11 to 19 to contact school nurses confidentially, by sending a text message, at a time of their choosing. Nurses provide timely healthcare advice by reply, with no message going unanswered.

All messages from users’ handsets arrive in a central inbox which can be accessed by all members of the clinical team. This facilitates remote and shift working to increase efficiency and capacity for the healthcare staff. The opening times for the messaging service are governed by the service provider, with automatic bounce backs sent when the service is closed, redirecting any urgent need for medical care to other services.

Onsite implementation and training is provided to ensure successful integration of the service. Once operational, technical support is provided and sites are encouraged to provide feedback suggested enhancements to the developers.

The service does not replace face to face services, but offers an alternative to those who are reluctant to use that service. Teenagers in particular can struggle with discussing sensitive issues such as self harm and mental illness face to face, and these are the group ChatHealth supports. The pilot reported half of all contacts began anonymously, with uptake of the service amongst males doubling compared to face to face clinics.

The app can increase staff efficiency, reducing strains on the service, whilst enhancing its acceptability to users. Practice shows that one nurse can triage a population of 65,000 pupils. Moreover, earlier contact with pupils due to fewer barriers to access, prevents problems escalating, reducing the need for more costly interventions later, hence further reducing demands on NHS and social care. Text messages from service users can be sent from any kind of mobile handset and are charged at the usual network messaging rate. Costs to service providers are based on specific requirements and are provided on request.

### EVIDENCE

#### Evidence to date

A one year pilot study was conducted in three local schools in Leicestershire. During the study feedback was obtained from service users and staff using video interviews, mystery shopping, feedback workshops, and reviews of anonymised transcripts. During the pilot, 3,500 messages from service users were delivered, receiving an additional 750 health contacts without impacting nurse capacity. Anecdotal evidence from users confirmed that they found the service quick and easy to use, and it was easier to talk about embarrassing subjects because of the anonymous feature. Nurses were confident in applying their existing skills for dealing with mental health and self-harm, etc. to deliver a safe service. Where referrals to other service were made, it was felt that the messaging system had improved interagency working. Nurses also stated it reduced time on calls, in clinics and travel time. Such feedback informed the standard operating practices and led to numerous updates to the staff app.

#### Evidence going forward

Much positive feedback from staff and young people has been captured but due to a lack of baseline measurements being taken before implementation, more detailed outcomes evaluation has not been possible. The Chat-Health team are now working with the East Midlands AHSN to develop a before and after measuring tool, which will inform indicators on resource use and hence the cost-effectiveness of the service.

A second tool is also planned to be developed in conjunction with the independent organisation, Patient Experience Network, to capture user satisfaction.

The ChatHealth team is also working with Warwick Medical School on a study to identify the impact, costs and necessary safeguards for digital, clinical communications for young people engaging with specialist NHS providers. The research will focus on those with long-term health conditions who tend to disengage from health services resulting in poor health outcomes, and will investigate whether and how their engagement can be increased using digital communication to improve health outcomes. 1

#### LESSONS LEARNED

- Meaningful evaluation of outcomes is not feasible if baseline measurements are not taken prior to implementation of the app;
- Demonstrating that apps are safe and cost saving whilst improving care is central to successful app development;
- Apps and related tools (e.g. SOPs) must be malleable so they can be adapted to different services;
- High quality user feedback is essential at all stages in an app’s life cycle;
- Use of AHSNs and other organisations during design and implementation can help to ensure the app and related tools are robust, and can reassure users of safety.

### REFERENCES

1. Warwick Medical School. Improving health outcomes for young people with long-term conditions: The role of digital communication in current and future patient-clinical communication for NHS providers of specialist clinical services (the LYNCs study). Available from: [http://www2.warwick.ac.uk/fac/sci/med/research/lyncs/](http://www2.warwick.ac.uk/fac/sci/med/research/lyncs/)
Case Study with myhomehelper

Developers: Kevin Marsch
Simpla Solutions

DESCRIPTION OF THE APP

myhomehelper is a memory aid to assist people with memory deficits, their families and carers. The condition may arise for several reasons including brain injury, dementia or learning difficulties. It is aimed primarily at those who are on their own for part of the day, and is designed to increase the user’s independence, and reduce anxiety and isolation, whilst giving peace of mind and reassurance to carers and family members.

The system comes pre-installed on a tablet computer which is kept in a visible location in the user’s home. It is pre-configured so runs from the moment it is turned on. A simple set-up system can be accessed by family, friends or carers, via the myhomehelper website, to tailor the system to the individual’s needs. There is no interaction required by the end user other than looking at the display, although it can be interactive, e.g. to request users to identify when tasks are completed. Features include a calendar clock, diary, timed and random reminders, photos, news headlines, auto answer Skype video calling, Facebook messages, night mode, SMS and e-mail system to carers.

The cost of the system is £333 (ex-VAT) for the first 12 months, and £78 per year thereafter to continue using the online features. This cost includes the tablet computer, myhomehelper subscription, tablet stand, 12 month warranty and on-line technical support.

Figure 1: Screenshots of myhomehelper

Development process

The app was developed in 2010 by Kevin Marsch in response to the needs of his mother who was suffering with vascular dementia. It began as a much simpler version of the app with just a diary screen so his mother could see where he was and how to contact him. Seeing how effective this was at reducing her anxiety, Kevin continued adding more features, and after receiving positive feedback from a range of professionals including carers, GPs and paramedics, he stopped work to focus on developing the app. The website was built in 2011 and piloted with 5 users in Hull who were identified by a local charity. The users and their family members provided useful feedback on usability and hardware which enabled the website and app to be developed further. Kevin spoke to a wide range of potential users and customers such as councils, care organisations, and charities including Age UK and Dementia Care, in order to get further feedback on its usefulness and usability plus raise awareness. The app was officially launched in 2014. The system is updated in response to user feedback and to meet new potential applications such as medicine management.

Safety of the app in use

myhomehelper is not designed to replace personal visits or care, but as an add-on to existing service provision. Therefore, there are very few safety issues associated with the app. Rather due to its high customisability particular safety concerns for an individual person can be mitigated using the app. For example, the app can be modified to facilitate supported discharge from hospital and monitor adherence to medication.

Adoption

Adoption of the app was initially quite slow, however some NHS trusts and councils have seen the potential and are introducing the app into their areas. Conway and Wrexham councils have started to use the app for patients who have suffered from brain injury, stroke or dementia to enhance independent living and speed up the transition from hospital to home. Services in the Manchester area are using the app within re-enablement services to promote independent living for users, and are trialling the app to improve compliance with medication by using the app to get feedback when pills have been taken. The app is used to route a message back to the service for action if a patient is not taking their medications on time. In 2013, Sheffield Teaching Hospitals NHS Foundation Trust started using the app in one of its community areas.

myhomehelper won the AbilityNet National Technology Good Peoples Choice award in 2013, and was selected as a finalist for the National Dementia Care Awards in 2014. The app is receiving interest worldwide and the developer is working on a plan to grow the business sustainably.

Figure 2: Screenshot of Online Carer Portal

EVIDENCE

Evidence to date

A case study was undertaken based on a single-user from Barnsley with severe problems which could not be solved by council staff and others. The developer worked collaboratively with service providers and was able to demonstrate very positive benefits after just 2 weeks. Thereafter, Barnsley Council introduced the app into 25 homes, with the University of Sheffield undertaking an independent service evaluation after 12 months. Questionnaires and a workshop were used to gather data on usability, functionality and impact of the service. The evaluation was positive, with users reporting reductions in anxiety and increased independence. A report was produced by Barnsley Council but has not been published.

A further 8 case studies were undertaken in Wrexham in June 2015 with users ranging from those with dementia to those with head injuries or brain tumours. The users were all relatively young with young children, and struggled with short term memory loss, forgetting household tasks and appointments. After 12 months of use, user response was very positive; anecdotal evidence showed it helped users to get to their appointments, helped them to remember to pick up their children from school and remember important events such as birthdays. It has also enabled spouses to continue working and supported family relationships through stressful times. No formal measurements of quality of life were taken at baseline or after implementation of the app.

Evidence going forward

The developer has no plans to conduct any formal clinical trials but encourages organisations using the app to undertake and publish their own evaluations.

Wrexham County Borough Council staff are keen to undertake further case studies using appropriate quality of life measures to quantify the impact of the app on quality of life, ability to manage everyday activities and on resource use.

LESSONS LEARNED

• Adoption was initially hindered by lack of published evidence. Councils wanted to see proof of efficacy in the form of evaluations before funding adoption;
• Developing the app using feedback from small pilot sites and in response to needs of caring organisations and users ensured that it was patient-centered at launch;
• Patient feedback is essential even with a mature app to drive further development;
• Flexibility throughout the development process has enabled the app to adapt to serve a wide range of health and social care needs.
• Small studies (n = 1) can inform adoption where safety is not a concern.

REFERENCES

Big Health Ltd

Case Study with Sleepio

Developers: Professor Colin Espie, Peter Hames & Big Health team

DESCRIPTION OF THE APP

Sleepio is a digital sleep improvement programme that aims to improve sleep using Cognitive Behavioural Therapy (CBT) for insomnia. CBT aims to address cognitive and behavioural factors associated with insomnia to overcome poor sleep and the negative emotions that accompany the experience of being unable to sleep. The programme is effective in long-term poor sleepers, including those taking sleep medication, but can also be used by those with milder sleep problems. Sleepio has been shown in clinical trials to reduce time taken to fall asleep and awakenings during the night, and to improve sleep quality. It has also been found to resolve daytime effects of poor sleep.

The Sleepio programme starts with an in-depth assessment which tailors the programme to the user's needs. Users are then introduced to CBT by an animated virtual sleep therapist (The Prof), and his narcoleptic dog, Pavlov. The course consists of six core weekly sessions and an array of interactive tools such as the sleep diary, progress tracker, relaxation MPs, thought checker and library of expert articles. Continuous support is also available via the online community, a forum for all users of the programme to support and help each other. In addition, users can get answers to their questions during one of the weekly sleep expert Q&A sessions. Both the website and App are designed for 'the sleepie mind'. This programme was developed to be accessible for users who are less confident with technology. No specific versions are available for blind or deaf people, or for those speaking other languages than English.

Individuals can purchase Sleepio for £3.85 per week for a year's access. When research trials are recruiting, eligible individuals can sign up to participate for free (pricing at May 2016: latest pricing at www.sleepio.com/try). For interested organisations there is a Sleepio at Work programme which is tailored to the needs of large employers.

Figure 1: Screenshot of Sleepio app

Development process

The Sleepio programme was developed by Professor Colin Espie (University of Oxford), a world-renowned expert in sleep and insomnia, and Peter Hames, a former sufferer of insomnia. Hames wanted to make the techniques he learned via a self-help book written by Prof Espie more widely accessible via a web-based system. Sleepio was produced by a team of designers, engineers and clinicians via an iterative process which included user interviews and iterative testing of prototypes.

A critical step during development was to gain evidence of effectiveness via a randomized placebo-controlled trial (RCT). No harm-related or serious adverse events were reported and participants in the Sleepio arm reported statistically and clinically significant improvements in outcomes. Attrition rates were low.1,2

Ongoing user feedback and scientific research are still key to optimising the usability and quality of the product. User feedback is collated and reviewed every week from the customer service helpdesk and end of programme user feedback forms.

Safety of the app in use

All advice given to users by Clinical Experts and Customer Service teams follow written Clinical Governance Guidelines. This includes standardised responses to frequent inquiries to ensure that only robust evidence-based information is provided to users. Adherence to the Clinical Governance Guidelines is overseen by a Clinical Lead.

Adoption

The programme has been available directly to members of the public since 2012 via www.sleepio.com. Adoption by NHS service providers was initially slow due to lack of awareness of evidence-based alternatives to sleeping medication, and limited acceptance of digital treatments. There is no established mechanism for prescribing Apps in primary care, which makes commissioning and reimbursement challenging. An increasing evidence base has led to several mental health service providers in England piloting the programme, and adoption is increasing. An audit of early outcome data demonstrated that Sleepio exceeded national recovery benchmarks as a therapeutic tool for anxiety and depression.3 The team is committed to further clinical evaluations, including cost effectiveness analyses, to be able to make a stronger business case to providers.

In 2015, Sleepio's CEO, Peter Hames, was selected for the NHS England Innovation Accelerator (NIA) Programme. The NIA role was extended to Dr Sophie Bozhich, Big Health's UK Operations Lead, in 2016.

EVIDENCE

Evidence to date

A self-funded RCT, was conducted prior to the launch of Sleepio to ensure clinical effectiveness and safety. 164 participants with persistent insomnia were recruited and randomly allocated to one of three groups: the Sleepio programme, a placebo course using the same online system, or no intervention. Sleep disturbance was measured before the start of the course, at the end of the course, and 8 weeks after finishing the course. Results demonstrated that Sleepio helped around 75% of people with persistent sleep problems to improve sleep efficiency to a healthy level, outperforming the placebo and no treatment groups. Average time taken to fall asleep was reduced by more than 50%, and time spent awake during the night by more than 60% in the Sleepio group. Effects were maintained over an 8-week follow-up period.1,2

A community based RCT was conducted in 134 hypertensives patients who were randomised to either usual care or usual care plus Sleepio (CGT). Outcomes were assessed at baseline and post treatment, and Sleep Correlation Indicator (SCI) scores were significantly higher in the Sleepio group and a significant improvement was also observed in 'presenteeism' demonstrated by the Work Productivity and Impairment questionnaire, but effects for absenteeism failed to reach statistical significance. Improvements were sustained at 8 weeks follow-up.3

An RCT was conducted in 223 participants who were randomised to either Sleepio or a waitlist group. Outcomes were measured to both sleep and work and included mood, job satisfaction, self-control, organizational citizenship behaviour and counterproductive workplace behaviour. Outcomes were assessed at 10 weeks and the Sleepio group showed significant improvements in sleep quality as well as mood, job satisfaction and self-control.4

An RCT in which 330 individuals with insomnia were randomised to either Sleepio or a sleep information control. Sleepio was found to decrease insomnia severity and also showed a significantly lower rate of clinically significant depression post treatments. The manuscript of this trial has been submitted but is yet to be published.

Recently, Sleepio was singled out as an example of good practice for mental health apps in Nature2. In particular, it was noted that most mental health Apps lack any adequately controlled evidence base, and are subject to a 'digital placebo effect'. Details of further trials conducted using Sleepio can be found here: https://www.bighealth.com/outcomes/

Evidence going forward

Sleepio has several collaborations with universities around the world to continue collecting evidence. For example, an RCT in 1,000 community participants meeting criteria for insomnia disorder is currently underway with the aim of assessing the impact of ACBT for insomnia upon health and well-being and will investigate sleep-related changes as mediating factors. Further trials and details about future plans for evidence generation can be found here: https://www.bighealth.com/outcomes/

LESSONS LEARNED

- Continuous user feedback and improvement is feasible and essential;
- The efficacy and effectiveness of digital programmes for NHS patients can be demonstrated using similarly rigorous clinical trials to other forms of treatment. Even where content is based on the best available evidence, research is needed to demonstrate effectiveness within NHS populations;
- Despite robust evidence and proven clinical efficacy, adoption of digital treatment programmes by the NHS proves challenging.

REFERENCES

Case Study with SilverCloud

Developers: SilverCloud Health

DESCRIPTION OF THE APP

SilverCloud offers internet delivered cognitive behavioural therapy programmes that can be accessed through their website or mobile app. Programmes are available for a range of mental and behavioural health issues including anxiety, depression, stress, eating issues, and chronic illness. Programmes are designed in conjunction with partners from academic and medical institutions and deliver evidence-based content with a focus on clinical outcomes. Users are encouraged to complete a weekly 30-40 minute session over an 8-10 week period, and are monitored by a ‘supporter’ who provides guidance and encouragement at regular reviews. Users are encouraged to share content such as goals for the week with their supporter and the platform also allows for secure messaging between user and supporter. SilverCloud also provides detailed reports to track the clinical effectiveness of treatments using a wide range of clinical measurement questionnaires, including the ‘Improving Access to Psychological Therapies (IAPT)’ minimum dataset of measures.

Figure 1: Screenshots of SilverCloud

Development process

The underlying concepts and requirements emerged from 7 years of research on technology to support the treatment of mental health issues at Trinity College Dublin, leading to a 3-year translational research project undertaken jointly by the National Digital Research Centre, Trinity College Dublin and Parents Plus, Mater University Hospital in Ireland. The development team was multi-disciplinary and brought together clinical, human-computer interaction, design and technical expertise.

A human-centred design process was followed, starting at the earliest phases with consultations with a range of stakeholders, including patients and design workshops. This fed into rapid prototyping and validation of prototypes with stakeholders over multiple iterations of the design. Expert review on clinical and human-factor issues was also carried out on high fidelity prototypes. The final stage before the first clinical deployment was extended usability testing with former service users. Further user feedback is gathered continuously and fed into the development process, with particular aspects of the platform the focus for phased redesign and improvement. Both qualitative and quantitative data are utilised. Programme questionnaires are the most common form of user feedback from patients, with some studies using patient interviews. Feedback from health professionals has generally been gathered through individual and group interviews. Quantitative feedback encompasses both clinical measures and analysis of usage logs in order to understand patterns of user engagement.

On-going formal research studies using the platform also provide user feedback and data which are helpful for design and development efforts (for example, helpful aspects of therapy and satisfaction with treatment measures can provide useful feedback).

Safety of the app in use

Development of the programmes included involving clinical experts from the Berkshire Healthcare Talking Therapies Team, alongside senior management and practitioners. Current best practice guidelines and treatment protocols were examined prior to developing the programmes. Mock-ups of intended programmes were examined by experts, and feedback sessions were conducted to ensure the programme met the specific needs of the Improving Access to Psychological Therapies (IAPT) model, including providing the minimum data set by which IAPT performance is monitored.

Adoption

Currently 47 NHS IAPT services have adopted SilverCloud to date. Uptake was improved, in part, due to the level of evidence around the app which includes a randomised controlled trial (RCT). Good service data and user experiences from early adopters of the service has encouraged greater adoption from other service providers. The service is also continuously updated with new offerings, such as new programmes to keep in line with the IAPT programme, which helps to further encourage adoption. Digital solutions that deliver psychological interventions for the treatment of common mental health problems such as depression and anxiety need to meet the same quality standard for safety, efficiency and effectiveness as would any other type of psychological intervention.

EVIDENCE

Evidence to date

The company believes digital solutions delivering psychological interventions must meet the same quality standard for safety, efficiency and effectiveness as any other type of psychological intervention. This has driven their approach to evidence generation. Initial studies focussed on user engagement, this being key to achieving positive outcomes in such interventions. A practice-based clinical study of 45 clients and 6 therapists used an online cognitive behavioural therapy programme for depression showed a high level of engagement and a statistically significant improvement in depressive symptoms in a subset of patients with moderate to severe symptoms (n=18), as measured by pre and post treatment assessments using the Beck Depression Inventory (BDI).

Following on from this, a service based effectiveness study was conducted, whereby 80 university students were recruited via university emails or signed up to the study by their therapist. All participants were assigned a therapist to support them online, and asked to use the programme for 8 weeks. User engagement was measured using descriptive programme usage statistics, and depression symptoms were measured using the Beck depression inventory II (BDI-II). Outcomes were positive, with 79% of users engaged with the programme at week 8 or later, and a statistically significant decrease in symptomatology of depression from pre to post intervention.

A RCT was conducted using a waiting list control design. Recruitment was of users of Aware, a depression or related mood disorders charity, via their website. Participants were randomised into two groups, with group 1 receiving SilverCloud and group 2, a waiting list control group received nothing for the first 8 weeks, and then received the intervention after this period. Participants were assessed at baseline and post-treatment, with the intervention group receiving additional follow-ups at 3 and 6 months. Primary outcome measures included BDI-II. A statistically significant reduction was seen in depression scores and other secondary outcomes in the intervention group compared to the control. These were maintained at 6 month follow-up.

Qualitative research has also explored other aspects of the interventions, including user acceptability and satisfaction. Results have been positive with most respondents reporting satisfaction with the programme (n=191).

Further studies include research into the events that participants consider therapeutically useful or hindering in their treatments, with an aim of improving user engagement and experience; research into participants presenting with more severe symptoms; and research into participants considered in the sub-clinical range of symptom presentation. This work is yet to be published.

Evidence going forward

Current plans include trials of the intervention at a step 3 service provision which includes individuals that present beyond mild to moderate symptoms. Along with developing their own evidence, SilverCloud are also involved with a European programme called ‘e-comparted’ which is examining the efficacy of blended treatment i.e. a combination of internet or mobile based interventions with face to face interventions.

LESSONS LEARNED

• Being able to demonstrate return on investment to management and staff of services providers can improve willingness to adopt the technology;
• Post-sale implementation and engagement processes are equally important;
• Procurement within the NHS can be highly complex, including multiple points of contact and extended, complex procurement processes;
• Apps requiring cultural changes or changes to clinical pathways may be met with reluctance/resistance;
• Integrating with NHS IT systems can be challenging.

REFERENCES