

**Do superfast broadband and tailored interventions
improve use of eHealth and reduce health related
travel?**

by

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee.

Work submitted for this research degree at the Plymouth University has not formed part of any other degree either at Plymouth University or at another establishment.

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ABSTRACT

Do superfast broadband and tailored interventions improve use of eHealth and reduce health related travel?

PHILIP ABBOTT-GARNER

Introduction – eHealth has been shown to have promising health outcomes in numerous areas, however many people remain digitally excluded and therefore suffer an inequality in health service provision. Lack of internet infrastructure, personal skills, and service provision have been identified as potential barriers to eHealth but as yet there is no good evidence of the significance of these barriers and the impact of interventions to improve them. This PhD aimed to assess impact on eHealth uptake of three interventions (i) superfast broadband, (ii) a tailored booklet to help participants improve personal internet skills and support, (iii) GP interventions to improve health service provision of eHealth. A subsidiary aim was to assess the impact on miles travelled.

Methods - In a cluster quasi-randomised factorial controlled trial, 1388 households from 78 postcodes were sampled in 2013 from the 20088 Cornish postcodes and allocated to the 8 (2X2X2) arms of the study. A unique sampling method was used to prevent contamination between arms. Comparison of 'eHealth readiness' and 'miles travelled' from baseline to 18-month follow-up between the 8 arms of the study was used to assess the impact of interventions. Interventions were tailored based on responses from the initial baseline survey and designed using aspects of the theory of diffusion of innovations. An overall eHealth Readiness score (0-10) was obtained from a validated self-completed questionnaire combining four sub-scales (Personal, Provision, Support, Economic). The standard deviation of the eHealth Readiness score represents a measure of eHealth inequalities.

Findings – No significant differences were shown between each intervention arm of the study, either singly or in combination (all $p > .05$). eHealth Readiness significantly improved over the 18-month trial period ($M=4.36$ vs $M=4.59$, $t(235)=4.18$ $p < .001$, $CI=0.13-0.35$). This increase is evidenced by increases in Personal and Provision scores ($t(255)=3.191$ $p = .002$, $t(258)=3.410$ $p = .001$). There was no change in eHealth inequality. The proportion of internet users, mobile use and happiness with internet speed also increased. Average travel to GPs did not significantly differ between baseline and follow-up (12.3 vs 13.0, $t(251)=.44$, $p = .66$). No correlation was shown between eHealth Readiness and total travel miles to GP practices.

Discussion – Individuals within Cornwall became more ready to adopt eHealth services over the 18 months of study, increasing in both their personal ability to use eHealth and their methods of access. This increase did not cause a larger digital divide. However, this increase could not be attributed to any of the three interventions. Further research should focus on making use of the improvement of infrastructure within Cornwall and seek to implement eHealth services. The eHealth readiness of Cornwall should be assessed in a longitudinal study to understand the effects of time of the superfast rollout. Qualitative studies should take place on persons of interest to help design more effective interventions with the aim to achieve a societal drive to sustainable use and adoption of eHealth.

Contribution to knowledge – Previously internet infrastructure has been acknowledged as a barrier to eHealth. This PhD was the first to analyse the impact of a high-speed internet rollout alongside other interventions on eHealth readiness. The methods in this study were unique and provide the basis for further work, both in the creation of a sampling method to reduce contamination between cluster interventions and as the first time a measure of eHealth readiness and eHealth inequality has been used to assess the effectiveness of eHealth interventions.

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CHAPTER 1. INTRODUCTION

1.1 What is eHealth?

The term eHealth is now commonly used throughout academic research and the healthcare industry. Although eHealth can simply mean “using computer-based technologies in the health profession practice” actually defining the term eHealth is as difficult as defining the term “internet” [1]. A review conducted in 2005 [2] sought to define the contexts and settings in which the term eHealth had been used. The review identified 51 unique published definitions, all of which specifically mentioned the universal themes of health and the technology involved. Six less general themes were identified (commerce, activities, stakeholders, outcomes, place and perspectives). The widespread use of the term eHealth suggests that it is an important concept for which a tacit understanding of its meaning exists. Even though no precise agreed upon definition exists, a widely used and accepted definition for eHealth is that of Eysenbach’s [2]. Eysenbach [3] defined the term as:

“eHealth is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.”

eHealth can be a ‘mother term’ which encompasses many services via the partnership of technology and health. Over recent years the internet has become an increasingly useful source for health related services including (i) seeking information from online resources, (ii) interacting with applications that

support patient decision making or change health-related behaviour, (iii) viewing or contributing to medical records, (iv) seeking emotional or information support from peers, or (v) communicating with professionals online [4].

The overwhelming understanding of eHealth reflects an attitude of optimism. Of the 51 definitions identified in Oh et al [2], all had positive connotations and included terms such as benefits, improvement, enhancing, efficiency, and enabling. One definition suggests that eHealth allows patients and professionals to "do the previously impossible". None of the published definitions suggested that eHealth could have any adverse, negative, harmful, or disadvantageous effects. With rapidly increasing technology and the public adoption of easily accessible and convenient online services, such as internet banking, the potential to utilise technology in healthcare appears endless.

However, the ability for everyone to access and use this technology effectively is still an issue nationally. The Office Internet Institute [5] reported that 22% of the British population did not use the internet in 2013. This disparity, often referred to as the digital divide, has the potential to cause an inequality between users and non-users. People who stay offline do not have access to the same technological opportunities; life chances, resources, participation opportunities and development of skills and capabilities [6]. A review by Van Dijk [7] identified five inequalities referred to by the digital divide: technological, immaterial, material, social and educational. Such inequalities must be considered with regards to eHealth and can serve as potential barriers to its use. These barriers include lack of physical access, experience, attitudes, confidence or self-efficacy, knowledge, and social help [4]. There is a potential risk for a divide to exist in healthcare, with digitally excluded individuals having less treatment options or potentially receiving poorer healthcare. This divide

could become more apparent with the implementation of 'Digital First' across the NHS [8], which aims to reduce unnecessary face-to-face contact between patients and healthcare professionals by incorporating technology into these interactions. For both social justice and health service efficiency it is essential to address these inequalities and the barriers that may cause them. In view of this, it is vital that effective interventions which help reduce the digital divide, with regards to eHealth, are identified and developed.

1.2 Cornwall

Cornwall is a county located in the south west of England. It has an estimated population of 532,300 spread across a large land area (3,563 km²) making it a very rural area of the country with a population density of 1.5 (persons per hectare) vs the England average of 4.1 [9]. It is distinct from many other rural counties because rather than having one, large central conurbation in an otherwise rural area, Cornwall shows a dispersed settlement pattern of numerous towns and villages and hamlets. Approximately 27% of the population live in the urban areas of Penzance, Camborne-Pool-Redruth, Falmouth-Penryn, Truro, Newquay, St. Austell and Bodmin. 29% live in towns and larger villages and 44% live elsewhere [10]. The population distribution is an issue for accessibility for rural areas to healthcare, transport, employment, ICT, training, community facilities and services such as shops, schools, childcare, sports and cultural activities. As a result, many people depend on private vehicles to access services. Over a quarter (27%) of Cornwall's carbon emissions are caused by transport, with car associated emissions accounting for 63% [10].

The rurality and access to services is of further concern coupled with the fact that Cornwall has an aged population, with a total of 29.7% of its population aged 60+ compared to 22.3% nationally [9]. In line with national trends, Cornwall's population is getting older as average life expectancy continues to rise. Should access not improve, potentially a large proportion of Cornwall's population could become isolated from important services such as healthcare. Use of the internet has the possibility to significantly improve the availability of services to rural areas; arguably one of the main benefits of the internet is its capability to be accessible to anyone almost anywhere. An individual can view a wide range of health information; seek support in a forum or converse with a medical professional all without having to leave their home. However prior to the Superfast Cornwall project (introduced below), the internet infrastructure throughout the county was poor, with a maximum download speed averaging around 5-6 Mbps in the more urban areas [11] and some 'not spot areas' having no access to the internet. In addition, the reliability was poor, meaning internet access could often fluctuate during the day.

1.3 Superfast Cornwall project

Superfast Cornwall is a pioneering programme funded by the EU, BT and Cornwall Council aiming to provide superfast broadband infrastructure to Cornwall and the Isles of Scilly, making it arguably one of the best connected places in the world [11]. Superfast broadband is the next generation of broadband, providing a faster and more reliable service; it can deliver speeds of up to 330Mbps. Broadband delivery UK (BDUK), in line with the Ofcom definition, defines superfast broadband infrastructure as an infrastructure capable of delivering internet speeds higher than 24Mbps [12]. Introducing high speed broadband to the rural area of Cornwall is a significant engineering task

costing an estimate £132 million and requiring the installation of 130,00km of fibre optic cable [11]. The programme will run until 2015, by which time fibre optic superfast broadband will have been introduced within reach of at least 95% of homes and businesses in Cornwall and the Isle of Scilly. In addition to this, Superfast Cornwall aims to provide alternative technologies, such as satellite, wireless and advanced copper to premises which are unable to be connected to the fibre optic network.

1.4 Assessing the impact of Superfast Cornwall on eHealth use

Although poor internet infrastructure is recognised as a barrier to eHealth, there is a lack of knowledge as to whether improving internet infrastructure alone is enough to improve the uptake of eHealth services. Even with good infrastructure there is great variability in NHS provision, at present the NHS does not offer a standard eHealth service throughout the country for each GP and Hospital. This means that offered eHealth online services can differ based on locations and GPs in the area. This has the potential to create an inequality in health service provision based solely on geographical location. Households may have different levels of expertise, support, motivation, and economic ability to use the Internet for health. Direct assistance or simply making people aware of resources and help, may be used to try to improve uptake of eHealth. Potentially identifying the needs of an individual can allow for the provision of tailored interventions to help reduce personal barriers.

With the installation of Superfast Cornwall, it provided an opportunity to assess the impact which an improved internet infrastructure can have on the uptake of eHealth and the reduction of health-related travel. In addition to this, it provided the opportunity to identify and assess the effectiveness of other interventions

designed to increase eHealth use, both singly and in combination, which can be conducted on a large scale and can also be repeated across the country.

1.5 PhD structure

This PhD is structured in eight chapters. Chapter one, the current chapter, provided an introduction into eHealth, the county of Cornwall and the Superfast Cornwall project which provided the opportunity to conduct this PhD. The second chapter provides a systematic review of the literature and highlights the potential benefits of eHealth, the inequalities in access to eHealth and how and why these inequalities could be addressed. Chapter three discusses the methodological options considered for this body of work and then details the method of research. Chapter four analyses the responses to the baseline survey. This is followed by chapter five which details the design of the tailored interventions and process of conducting the interventions. Chapter six analyses the results of the cluster Quasi-RCT using before vs after analysis to examine differences between study arms. Chapter seven provides a discussion of the results and their context in the current body of research within the area of eHealth. Finally, chapter eight, the conclusion, summarises the PhD and outlines the contributions to knowledge, the limitations of the study and the recommendations of future research.

CHAPTER 2. LITERATURE REVIEW

The literature contained within this thesis has been identified through systematic searches of a range of databases including Cochrane library, MEDLINE, PsycINFO, PUBMED, EMBASE, CINAHL and Web of Science. A methodical approach was applied using the search terms listed in Appendix A. Keywords identified from the results of initial database searches were incorporated into subsequent searches. Inclusion and exclusion criteria were developed for each search. When relevant literature was identified the author(s) names were used to search for further papers, in addition to this, papers citing key literature were identified using 'cited by' search on Web of Science. Google search engine was used to identify 'grey literature' not indexed in main databases. Citations that did not appear to be relevant were not examined further. Where citations appeared to be relevant to the inclusion criteria the abstract of the paper was retrieved for further scrutiny and if the paper appeared to meet the inclusion criteria the full document was retrieved. The results of this process are documented in Appendix A. All papers meeting the inclusion criteria were critically appraised against CASP guidelines. An initial search was undertaken in March 2014. A subsequent search was conducted in July 2016 to identify, and include, any further relevant papers that had been published following the initial review.

2.1 Examining the potential benefits and limitations of eHealth

Ekeland et al [13] conducted a systematic review of reviews to examine the impacts and costs of telemedicine (eHealth) interventions. A total of 80 reviews met the inclusion criteria encompassing a broad range of interventions. Twenty-one of the 80 concluded that eHealth has had positive outcomes

including therapeutic effects, increased efficiencies in health services and technical usability. Several of these reviews examined internet based interventions including Barak et al [14] who conducted a meta-analysis of psychotherapeutic eHealth interventions and reported a mean weighted effect of 0.53, similar to the average effect size of traditional face-to-face therapy. Further comparison of 14 face-to-face and internet intervention showed no difference in effectiveness, demonstrating that internet based intervention can be as effective as face-to-face interventions. Myung et al's [15] meta-analysis of RCTs indicated that there is sufficient clinical evidence to support the use of Web- and computer-based smoking cessation programs for adult smokers. Two of the identified reviews examined the effect of internet based cognitive behavioural therapy (eCBT) on treatment for anxiety [16] and symptoms of depression [17]. Both reviews provided support for the use of eCBT with studies showing superior outcomes compared to waitlist and placebo groups, and effects equal to therapist delivered treatment. However, both reviews were limited by number of studies, sample sizes, rare use of placebo controls, methodological problems and significant heterogeneity. These limitations were further echoed in other reviews reporting positive benefits. Van den Berg et al [18] indicated that there was evidence that internet based physical activity interventions were more effective than a waiting list strategy but the variety of study populations makes it difficult to generalise. Two remote monitoring reviews found that most studies reported positive outcomes, noting improved healthcare utilisation, behaviour, attitudes, and health skills in people with diabetes [19], and easy to use, widely accepted by patients and professionals and economically viable in the monitoring cardiac heart failure [20]. However, both reviews noted the large variation in patient characteristics.

The positive result of eHealth while acknowledging the limitations of research was a common theme reported in numerous systematic reviews. Nineteen of the identified reviews were less confident about the effectiveness of eHealth suggesting it was promising or had potential but stated that more research was required before it was possible to draw firm conclusions. The authors suggested that in cases where the same conditions and interventions were discussed, the more tentative conclusions should be used to counterbalance authors who found conclusive evidence. As an example, Cuijpers et al [21] systematic review of eCBT for health problems, found it to be a promising and a complementary development but reported 'effects slightly below the effect sizes found for internet-delivered CBT for specifically anxiety and depression'. This is contrary to the previously discussed eCBT reviews [16 17]. Several reviews agreed that eHealth showed therapeutic promise, a few of note focussed on internet-based interventions including Griffiths & Christensen [22] which reported improved symptoms, behaviours and knowledge associated with mental disorders. Two reviews [23 24] examined the effectiveness of computer and internet-based diabetes management showing benefits to users in both time and cost savings, however these were limited to short term programs with more research needed to characterise long term benefits. A review of internet-based weight loss programs [25] reported positive results at both reducing and maintaining weight although conclusions were again limited by methodological issues, as the majority of subjects were predominately white, educated women.

A further 22 reviews concluded that the evidence for the effectiveness of eHealth was still limited and inconsistent, across a wide range of fields. Frequently, the reviewers called for further research, notably in the form of RCTs. Several reviewers suggested that research has been somewhat

narrowly focused and suggested further research which takes a broader perspective or a different one. As an example Linton's review ([26] as cited in [13]) further contributed to the previously discussed disparity regarding eCBT effectiveness, suggesting while it appeared to be effective for panic disorders, social phobia and depression, its effects on obsessive–compulsive disorder and anxiety and depression combined remain insufficiently clear.

Despite large number of studies and systematic reviews on the effects of eHealth, high quality evidence to inform policy decisions in healthcare is still lacking.

A number of systematic reviews conducted post Ekeland et al [13] have focused on specific uses of eHealth. A review on tailored internet interventions for improving medication adherence [27] showed promising results on the effectiveness of internet interventions to enhance patients' adherence to prescribed long-term medications. Others showed promising results for (i) smoking cessation [28], demonstrating that internet interventions can assist smoking cessation at six months or longer, particularly those which are interactive and tailored to individuals. (ii) Sexual health promotion [29], with a meta-analysis indicating that sexual health knowledge was higher in interactive computer-based interventions compared with 'minimal interventions' (treatment as usual). And, (iii) computer-based cognitive rehabilitation (CBCR) for stroke patients [30], which conducted a meta-analysis of 12 studies, six high quality RCT's, demonstrating a medium overall effect size, providing evidence that CBCR is effective at improving cognitive function after stroke.

Many of the reviewed papers examined the effect of eHealth interventions on health and behaviour as primary outcomes. Despite often being acknowledged as a benefit to eHealth, economic results were often reported as a secondary

outcome with limited analysis. This echoes conclusions from Ekeland et al [13] who suggested that large studies with rigorous designs were needed to get better evidence on the effects of eHealth interventions on satisfaction with care and costs. Encouraging a stronger focus on economic analyses, patients' perspectives and on the understanding of eHealth as complex development process. As an example, a systematic review of the effects of eHealth on chronically ill patients [31] examined 12 RCTs designed according to the Cochrane criteria. Most of the studies showed small to moderate positive effects on health outcomes. However, cost-effectiveness and patient satisfaction were rarely investigated in the included studies with the authors again calling for further research to confirm the cost effectiveness of eHealth interventions.

Where economic outcomes have been examined, evidence appears promising. Elbert et al's [32] systematic review of reviews focussed on both the effectiveness and cost-effectiveness of eHealth interventions in somatic diseases. Of 31 eligible, seven (23%) concluded that eHealth is cost-effective and a further 13 (42%) underlined that evidence is promising. With the remaining, either not reporting costs or demonstrating limited/inconsistent proof. During this literature review a total of nine RCTs were identified which reported economic variables as a primary outcome (Appendix B, full summary). Several [33-38] highlighted cost-effectiveness in the form of lower cost per quality-adjusted life-year (QALY) gained, an economic evaluation to assess the value for money of medical interventions. One [34], which examined an internet-based treatment program for stress urinary incontinence, highlighted that cost per-person was higher for the internet delivered intervention vs a postal intervention. However, when considered on a national scale offered

significantly lower cost per QALY. Another [33] examined behavioural weight loss interventions delivered via internet chat session vs in person group sessions, again showing lower cost per QALY gained, even-though in-person sessions showed higher weight loss. This was due to reduced participant time costs, mainly due to decreased travel cost of \$158 per person.

Considering the potential to reduce travel it is possible the adoption of eHealth can help to reduce the carbon footprint of healthcare however high quality evidence regarding reduced carbon emissions seems limited. No systematic reviews or RCTs focusing on eHealth carbon savings were retrieved using the search criteria in appendix A. When this criterion was relaxed, to include non-RCT studies, several papers were identified that discussed the potential of eHealth using estimated reductions towards carbon emissions. For example Smith et al [39] highlighted examples which showed the potential of eHealth to reduce carbon emissions. A tele-paediatric service in Queensland, Australia, provided a range of specialist services to children living remotely. EHealth was used to manage 17% of paediatric outpatients with burns. Over a six year period, 1000 videoconference consultations eliminated an estimated 1.4 million km of patient travel, which reduced CO₂ emissions by 39 tonnes each year [40]. In Wales a neurologist conducted half of his rural clinics via videoconferencing which eliminated an estimated 2560 km of travel each year, and reduced greenhouse gas emissions by 705 kg [41].

Other case examples were highlighted in Holmner et al's [42] review article discussing climate change and eHealth. An eHealth programme in California conducted 13,000 outpatient consultations over a period of 5 years and resulted in a savings of 4.7 million miles of travel reducing 1,700 tonnes of CO₂ emissions [43]. Another eHealth service, started to assist multidisciplinary

teams in Wales improve cancer services, estimated that 38,800 km of car travel was avoided during a two-year period, equivalent to 4286 kg of CO². Finally, 840 telemedicine consultations completed in a 6-month time period [44], resulted in an estimated 757,234 km of avoided travel. Leading to greenhouse gas emissions savings of 185,159 kg carbon dioxide equivalents in vehicle emissions. More extreme estimations suggest that in Canada more than 11 million home visits by nurses could be replaced by eHealth, which would result in a reduction of about 120 million km of travel and 33.220 tonnes of associated GHG emissions annually [45].

There are several problems in trying to review the literature on the benefits of eHealth interventions. In any pragmatic RCT assessing a new treatment, there are problems of the representativeness of the sample which may be limited by entry criteria and the self-selection of those who agree to take part.

Recruitment and inclusion and exclusion criteria are particularly relevant, where those who do not have access to the Internet or those who are less IT literate may be excluded from trials [46]. Another major problem with eHealth research is the choice of comparison group or control. Often eHealth interventions are compared against a control group with no intervention, meaning the eHealth intervention is likely to have a positive result. In other studies, the 'treatment as usual' condition is often 'do nothing', or at least the eHealth intervention is offered in addition to 'treatment as usual'. In these cases, it is likely that an experimental effect will be observed, where 'doing something' is better than 'doing nothing' [47].

General concerns regarding eHealth have been raised particularly regarding privacy, or a worry that personal information might be compromised and the potential lack of a relationship with a provider [48]. A study by Mair et al [49]

found that patients were satisfied with their teleconsultations although half qualified their approval with an important factor of seeing a specialist for a face-to-face visit on occasion, suggesting that the service not replace all consultation visits.

Although there are methodological difficulties to consider and the need for further research, there is evidence of patient benefit from eHealth services. EHealth seems to have had a positive effect on knowledge, attitudes, behaviour, or health in areas including smoking, alcohol, weight loss, mental health and long term conditions. In addition, although limited in its analysis, it is important to consider the potential benefits of eHealth from an economical and environmental perspective. Shared information or online communication can reduce travel, cost and save time by eliminating unnecessary face to face visits increasing the efficiency of healthcare provision. Moreover, this could help reduce the carbon footprint of healthcare.

2.2 The digital divide and barriers to eHealth

The availability of eHealth services to everyone must also be considered. Arguably one of the main benefits of eHealth, or even the internet alone, is its capability to be accessible to anyone almost anywhere. However the Oxford Internet Institution's (OxIS) 2013 report [5] identified that over one fifth of the British population had not used the internet in 2013 (22%): 18% had never used the Internet and 3% had used it in the past but had stopped. Even though the proportion of non-users had been steadily declining from 35% of the population in 2003 to 22% in 2013, this demonstrated that potentially a quarter of the population were digitally excluded.

The Office for National Statistics (ONS) produced data from households with no internet access indicating the reasons given for none use [50]. Nearly a third (31%) cited lack of skills as a reason for not having internet access, 14% felt equipment costs were too high with a similar proportion (12%) thinking the same about access costs, 5% were deterred from gaining access by privacy or security concerns.

National figures [51] highlight the demographic differences in internet use with several key predictors including; (i) Age, there is a decreasing likelihood of internet use as age increases, individuals aged 75+ are five times more likely not to be using the internet than those aged 55 to 64. (ii) Income, households with the lowest income (<£999 a month) are significantly more likely to be non-users than households with higher income. (iii) Health, poorer self-perceived general health is more associated with non-use of the internet than good health, individuals with very poor health are over twice as likely not to use the internet as individuals with excellent health.

These figures highlight the existence of a 'digital divide' or inequality within the UK, to some degree 'eHealth inequality' can be categorised as purely the digital divide applied to health. Barriers preventing an individual from accessing and using technology will inevitably prevent them from using eHealth services, however other issues may prevent use of eHealth which can be separate from internet use. A large study conducted in the U.S. [52] provided free internet access to 12,878 individuals, of those who obtained internet access for the first time less than a quarter (24%) used it to access health information during the course of the year. There is also evidence that poor health literacy can continue online, low health literacy is associated with significantly less use of the internet for health information among individuals aged 65 and older [53].

Differential access to information and computer technologies is related to individuals and their characteristics, level of income, education, employment and age [54]. Although this provides useful data, it does not automatically result in explanations of questions such as; what it is about age that produces the observed differences? Considering the binary digital divide, the differences between the "haves" and "have nots" regarding access to the internet alone, limits the scope of eHealth inequality [55]. There are additional factors that extend beyond internet access and use, during this review several barriers were identified which can be categorised into; (i) Provision, (ii) Personal, (iii) Inter-personal and (iv) Economic.

2.2.1 Provision

Inevitably a lack of access or poor access to the internet and/or computers are significant barriers to eHealth use and are commonly cited [56-59]. As a few examples; individuals with home internet access across three disparate communities were much more likely to search for online health information and bring obtained information to their doctor, than those with none [60]. A survey on cancer patients indicated that only 10% had used the internet themselves to obtain cancer information, with 44% reporting that they would use the internet to obtain cancer information if they had internet access [61]. Parents of disabled children who did not have access to a PC at home were more likely to have never used the internet [62].

The quality of access also has an impact, in 2014 the average broadband speed in rural dwellings in a sparse setting was 5 Mbit/s compared with 27 Mbit/s in major urban areas [63]. The disparity of quality high speed broadband has the potential to limit access to health services delivered via the internet, and

is certainly evident in more extreme cases of speed discrepancies, dial-up vs broadband viewing of web videos and images [64 65]. Research on Canadian teenagers [66 67] found that while nearly every Canadian teenager had access to the internet, far fewer had the quality of access fully utilise it for health. Even with more modern technology which are present in UK rural areas, such as a low speed broadband connection, problems can occur. Participants of group-based pulmonary rehabilitation delivery via videoconferencing occasionally experienced low-quality video due to slow internet speeds [68]. Internet access may be better described as a range from the have-nots to the haves-with-unmitigated-access. Using services such as video consultations will require a reliable and 'quick' internet connection. The use of mobile phone technology could help [69] but coverage is poorer in rural areas and typically during peak hours network congestion often occurs [57].

A large amount of research has focused on the user's ability to access health information via the internet, however less have recognised that variation in eHealth services is also an issue. UK GP websites vary in availability and functionality. In 2011, while some practices provided information, appointment booking, repeat prescribing, online advice, and patient access to their medical records, other practices had no website [70]. The number of practices with websites varied across England from 35% in Southend to 94% in Harrogate [71]. In secondary care, some conditions are better served for health information. Most British renal patients have access to their renal medical record online [72] but few if any stroke patients have such facility [70], video consultations have been utilised for dermatology [38 40] but not adopted in general practice.

Healthcare providers may struggle to provide eHealth services for several reasons. Interoperability, the ability of a system or a product to work with other systems, is an issue. Data in a medical information system comes from different sources including administrative data, health statistics and medical records. As data from different streams has to be correlated, analysed and processed to generate relevant reports, the data will have to be standardised to make it relevant and useable [73]. The lack of a holistic approach or a lack of standardisation among hospitals also makes it harder to develop a uniform health information system that can standardise treatments, medical processes and operations [74]. However, as medical staff often suffer from a heavy workload, they lack time and motivation to get involved in the eHealth development processes. Furthermore, failure to effectively communicate the potential benefits of eHealth can lead to a lack of motivation [75].

2.2.2 Personal

Physical and psychological attributes can also act as barriers and contribute to eHealth inequalities. Inevitably, a lack of skills or experience in using computers and the internet can prevent use (e.g. [52 62 76 77]). Individuals may distrust the internet [78] or the health information it provides [79-81]. They can lack the motivation to learn, or access eHealth services [82 83]. A person's current health may increase motivation to use the internet for health information [84 85], while also inhibiting their ability to do so [86].

Age-related changes in visual, perceptual, motor, and cognitive abilities can be major barriers to older adults' learning and using computers and the internet [59]. Reduced perceptual and cognitive abilities means older adults often

experience more difficulties in learning computer software to search and retrieve information from the internet [87-89].

Most internet health information is text based, meaning that low literacy populations can struggle to utilise the information effectively [90 91], those with lower levels of education also struggle [56 58]. Patients in a US study with lower levels of education had significantly lower odds of; (i) going online to look for a health care provider, (ii) using email or the internet to communicate with a doctor, (iii) tracking their personal health information online, (iv) using a website to help track diet, weight, and physical activity or (v) downloading health information to a mobile device [92].

2.2.3 Inter-personal

Some factors limiting use of eHealth may be moderated if people have an inter-personal support structure available to them [70]. Many non-users have some form of indirect access to the internet, via other individuals (proxy internet users). Proxy internet users are individuals who may go online to for example: send an e-mail, or find information on someone else's behalf. In the UK approximately 70% of non-users report having access to a proxy user but only 20% actually use this proxy to access the internet [93].

Non-users who do not have access, or choose not to use, a strong support structure may not have the same help to overcome fears and apprehension at the beginning [94]. With decreased social connection they may also lack exposure to the internet and other technologies [95]. They may not perceive usefulness in adopting it or have diminished motivation to do so [96 97]. If they are relying on family or friends to help, they may have to wait until they are available. Non-family members may be able to help; for example, anonymous

e-mail support may help people with long term conditions use the internet [98]. Or community access centres (such as UKOC [99]) provide a location for individuals to become acquainted with technology in a supportive environment [100].

2.2.4 Economic

Inevitably economic factors can inhibit the use of the internet and eHealth. As highlighted earlier, UK national figures indicate lower income households are less likely to access the internet [51]. This is also evident in the USA with 43% of families with incomes between \$15,000 and \$25,000 having a home broadband connection, compared to 86% of those with incomes between \$100,000 and \$149,000 [101].

Although homes may be capable of internet connection, families may not be able to afford it, someone relying on accessing the internet at their local library may be restricted by transport costs [70]. Women diagnosed with breast cancer were less likely to use the internet for health if they had a lower income, even after controlling for other predictors [102]. Lung cancer patients with higher income were also more likely to seek online health information about their condition [103]. Low-income populations often have lower health literacy [104] which can continue online[105].

Where interventions and provision are focussed, economic barriers can be reduced. A study directed designed to increase physical activity and reduce dietary fat among low-income students showed positive outcomes for even the poorest [106]. This is also true for low-income psychiatry [107], asthma [108] and cancer patients [109], to name a few. With appropriate provision, even the

poorest can achieve access; a U.S. study amongst homeless found that 47% reported computer use in the past month [110].

2.2.5 Should we address the divide?

As elderly people have the lowest adoption rate and level of use of ICT of all age categories many observers may assume that the digital divide is a temporary phenomenon that will fade away with successive generations of users who grew up with computers and the internet [111]. It is not unreasonable to argue that because the younger generations in general have had more experiences with technology at school and work, that as these generations age, they will be more familiar with computers and the internet than current older adults [59].

However, as the discussed research would suggest, in addition to sociodemographic factors, psychological concepts which bridge generations also contribute to differential levels of internet use. Interactions between future generations of older adults and technology might remain the same. Economic barriers may remain; if the cost of computer equipment and internet access are too high for future generations of older adults who have limited financial resources after retirement, then it is likely that they, even though they might have had prior experiences with the internet and eHealth, would have to reduce or even eliminate their use. Personal barriers may remain due to the seemingly exponential development of new technologies, the differences between older and younger adults' use of new eHealth systems are likely to be trans-generational [59].

Without considering the ethical argument for addressing inequality, eHealth inequalities make the adoption of more cost-effective health delivery difficult. If

health services must provide eHealth and more traditional services, this diversity of service provision may be expensive [70].

For both social justice and health service efficiency we need to address these inequalities and the barriers that may cause them. In view of this, it is vital that effective interventions which help reduce the digital divide, with regards to eHealth, are identified and developed.

2.3 Measuring eHealth inequalities

Effectively measuring eHealth inequalities is vital for several reasons (i) It allows researchers and other professionals to recognise whether action or an intervention is needed. (ii) It can help to identify and highlight the main causes of the inequality, allowing for further examination. (iii) It can identify if inequalities have been addressed and if interventions were successful [70].

However, inequality cannot be directly measured and must be measured as a difference in another variable. In eHealth research it is important to assess the degree to which a community or individual is prepared to participate and succeed in the use or adoption of eHealth, this can be termed 'eHealth readiness' [112].

Legare et al [113] identified six different assessment tools that used Likert scale questionnaires to measure eHealth readiness within a healthcare context.

These included; 'The Organizational Information Technology/Systems Innovation readiness Scale (OITIRS)' [114] which was designed to guide project managers in evaluation, diagnosis and resource selection for the different steps in patient care. The Organizational readiness for Change (ORC) [115] tool, developed to evaluate the readiness towards change in substance abuse treatment agencies. The Assessment of the readiness of Hospice

Organizations to Accept Technological Innovation [116], developed to measure the readiness of hospice organizations for using videophones in their patients' homes. The Assessing Care Agencies' readiness for Telehealth Tool [117], based on OITIRS, and created to measure the readiness for telehealth in home care. The EHealth readiness Assessment Tools for Healthcare Institutions in Developing Countries [118] developed to aid in planning eHealth programmes. Finally, Jennett et al [119] who developed three readiness assessment tools which could be used in several clinical contexts. However, only one was aimed at the patient level, which Legare [120] further translated into French and validated its use with staff. Despite this, no suitable tool that assessed patients' opportunities to participate in eHealth was identified [70].

Measuring inequalities at a user or patient level can adopt a purely binary approach, such as measures of the digital divide and internet inclusion, which can be reduced to simply whether someone has or does not have access to the internet or has or has not used the internet in the last three months [121]. However, this form of measurement on use or availability can reduce inequality to a too simplistic measurement, which ignores individual characteristics or attitudes. Even within internet users, some may be more ready to use eHealth services if they have access to support and are not struggling with the cost of access. An alternative approach focuses on the measurement of eHealth literacy, particularly the eHealth literacy scale (eHEALS) [122]. This measurement, designed by Norman & Skinner [122] and based on their 'Lily Model' [123] (discussed later), recognized that simple measures of whether or not someone has internet access are insufficient and personal abilities to use the internet were important. The eHEALS is an 8-item self-report measure of eHealth literacy developed to measure consumers' combined knowledge,

comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems [122].

However, a further validation study [124] highlighted that eHEALS relationship with internet use was weak and expected relationships with age, education, and actual performance were not significant. Furthermore, the scale is only appropriate or consistent for internet users. By adopting a more sophisticated examination of eHealth literacy, the basic ideas of the digital divide and limitations of access to the internet were lost [70].

The Patient EHealth readiness Questionnaire (PERQ) created by Jones [70] is designed to measure the impact of interventions, at patient and community level, which aim to improve eHealth readiness and reduce eHealth inequalities. The PERQ uses a similar approach to eHEALS, adopting the use of scales as opposed to a purely binary measure, but includes further variables and covers the full range of individuals from non-internet users through to frequent internet users. The PERQ consists of four components that construct eHealth readiness (1) the provision of internet and internet for health, (2) the personal ability to use it, (3) support in using it, and (4) economic barriers to use. The PERQ is acceptable in a British context with the produced scores appearing valid and sufficiently sensitive to enable the assessment of the effectiveness of eHealth interventions in the context of RCTs. Furthermore, by examining the standard deviation of scores, eHealth inequalities can be reviewed to ensure that interventions have not worsened inequalities [70].

2.4 The Diffusion of Innovations

Roger's Diffusion of Innovations theory [125] is arguably one of the most popular theories for studying adoption of information technologies (IT) and understanding how IT innovations spread within and between communities [126]. It seeks to explain how innovations are taken up in a population. An innovation is an idea, product, practice, or service that is perceived as new by its audience.

Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system and subsequently considered for adoption, utilization, and implementation. Some innovations are communicated and adopted at great speed, and others never appeal to many people. The difference in rate of adoption can often be explained by the differences in how the potential adopter perceives the innovation's characteristics, or attributes [125].

There are essentially four main elements in the diffusion of new ideas. (i) The innovation; meaning the idea itself, certain characteristics of an innovation can determine its adoption rate. (ii) Communication channels; allow the transfer of information from one person to the other by which participants create and share information to reach a mutual understanding. (iii) Time; the passage of time is necessary for innovations to be adopted; from first knowledge of an innovation to forming an attitude toward, to a decision to adopt or reject, to implementation and confirmation. Innovations are rarely adopted instantaneously and are often adopted at different rates for different individuals. Finally, (iv) The social system; a set of members that are engaged in joint problem-solving to accomplish a common goal. Since diffusion of innovations take place in the social system, it is influenced by the social structure of the social system.

Within the social system several adopter categories are present, these are a classification of a member's basis of innovativeness. Classifications include innovators, early adopters, early majority, late majority, and laggards. In each adopter category, individuals are similar in terms of their innovativeness. Innovators are willing to experience new ideas; they are the 'gatekeepers' bringing the innovation in from outside of the system. Early adopters are more likely to hold leadership roles, other members come to them to get advice about the innovation. As role models, early adopters' attitudes toward innovations are important. The early majority have good interactions with other members of the social system, their innovation decision usually takes more time than innovators and early adopters. Like the early majority, the late majority includes a third of all members of the social system. They are sceptical about the innovation and its outcomes and wait until most of their peers adopt the innovation. Close peers often persuade the late majority to adopt it, reducing the perceived risk of the innovation. Finally, laggards, who have the traditional view and are more sceptical about innovations and change than the late majority. Because of the limited resources and the lack of awareness or knowledge of innovations, they first want to make sure that an innovation works before they adopt. Laggards tend to decide after looking at whether the innovation is successfully adopted by other members of the social system in the past. Due to all these characteristics, laggards' innovation-decision period is relatively long [127].

All individuals or organisations go through 'the innovation-decision process' in which information-seeking and information-processing takes place, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation [125]. The innovation-decision process involves

five steps which follow in a systematic manner: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation.

In the knowledge stage an individual learns about the existence of innovation and seeks information about it. The persuasion stage occurs when the individual has formed an attitude towards the innovation, this may be positive or negative. The individual shapes their attitude after they know about the innovation, close peers' evaluations of the innovation that reduce uncertainty about the innovation outcomes are usually more credible to the individual [127].

At the decision stage in the innovation-decision process, the individual makes the choice to adopt or reject the innovation. In an active rejection situation, an individual tries or uses an innovation but decides not to adopt it. This is a discontinuance decision, which is to reject an innovation after previously adopting it. In a passive rejection (or non-adoption) position, the individual does not think about adopting the innovation at all.

At the implementation stage, an innovation is put into practice. Reinvention usually happens at the implementation stage the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. As innovations, computers are the tools that consist of many possible opportunities and applications, so computer technologies are more open to reinvention.

Finally, at the confirmation stage, the individual looks for support for his or her decision. This decision can be reversed if the individual is exposed to conflicting messages about the innovation [125]. The individual tends to ignore these messages and instead seeks supportive messages that confirm his or her decision. Attitudes become more crucial at the confirmation stage. The individual rejects the innovation because they are not satisfied with its

performance or a discontinuance decision may be that the innovation does not meet the needs of the individual.

The diffusion of innovation helps explain the adoption of technology but also provides insight into why some people choose not to adopt certain technologies. Individuals may not possess knowledge about the innovation, perceive it to be too complex to learn. They may not perceive its benefits or the advantage of adopting the innovation. Furthermore, they may seek confirmation from peers who hold the same opinions as them and therefore they do not receive any conflicting information of the innovation.

2.5 Interventions to increase eHealth Use and provision

2.5.1 National digital divide programmes

There is an evitable link between eHealth use and internet use, for this reason it is important to consider interventions which have been attempted throughout the UK to facilitate internet use and reduce the digital divide.

Various projects have previously been attempted to help facilitate general internet usage. The UK online centres (UKOC) network was set up by the government in 1999 to provide public access to computers. Since then the role of UK online centres has developed to become more about inspiring people to get online, and supporting them to gain the skills and confidence they need to use the internet and to take advantage of online public services [128].

According to the UKOC website [129] 1,177,837 people have learnt with the organisation since 2010. As a part of the Social Exclusion Action Plan, UKOC launched 20 projects across 150 centres over the course of 15 months, the projects sought to reach socially disadvantaged people and engage them in ICT activities through various outreach models. Models included outreach

initiatives, home access pilots and home delivery, group sessions and one-to-one tuition [130]. Throughout the course of the project 12,234 were engaged at a cost of £163 per participant, weekly internet usage increased from 50% to 85%, 60% of participants said they were now happy using the internet and 70% reported that they felt more confident because of the project. Although £163 per participant reached appears high, UKOC argued that the project attempted to make a deep impact on seriously marginalised individuals and in doing so the resulting positive impact for these individuals far outweighed the cost per participant.

Considering the reported outcomes of the project, engagement models, such as those discussed, partnered with ICT training provided by UKOC appear to be effective at increasing internet usage. However, the initial baseline survey was completed by 1,727, a series of tracker surveys (every 2 months) were also given to participants, at the time of the 4th tracker (after 8 months) only 19 individuals had responded and these results were excluded from analysis. A final survey was conducted in May 2008 and received 191 responses, an attrition rate of 89%. The large attrition could suggest a large majority of participants did not benefit or were not happy with the project. If intention to treat analysis is applied (taking none responders as no change) the final weekly internet usage would be 55%, an increase of just 5%.

Various other national initiatives such as Go ON UK [131], a charity seeking to ensure that everyone is able to enjoy the social economic and cultural benefits of the internet, support people to gain the skills and confidence needed to use the internet and online public services. Go ON UK working in conjunction with other organisations such as Age UK [132] aim to make people aware of resources through advertising and also help to improve internet usage. A large

campaign throughout Liverpool utilized BBC media, launch events, politicians, local authority resources alongside recruiting 'Digital Champion' volunteers who provided support, guidance and encouragement for others to become digital champions. Although no direct analysis was conducted, ONS statistics showed a reduction of 5.6% of non-internet users in the area compared to 1.1% nationally [133].

The method of providing training, either by professionals or volunteers, alongside access to equipment has been well utilised in various national projects. Although specific in-depth analysis of outcomes and long term effectiveness is not well documented, there is some evidence to suggest that national programmes and organisations can be effective in increasing general internet usage. There is the potential for this national infrastructure to be utilised to aid in rigorously designed intervention studies.

2.5.2 Increasing individual's eHealth Use

Much of the discussed literature has focussed on the health outcomes of eHealth interventions. It has detailed the potential benefits which can be achieved using effectively delivered internet health programmes. For these benefits to be realised by all, an initial intervention must take place to ensure individuals are eHealth ready and capable of adopting the service. Numerous barriers have been highlighted which may be in place that prevent an individual from adopting eHealth. There is a need to research and design effective interventions to reduce these barriers, evidence and research in this area is limited.

This is illustrated in Car et al's [134] systematic review of interventions to improve users online health literacy. The review assessed whether teaching

people to find, evaluate or use online health information (online health literacy) improved those skills and their health behaviour. Only two papers met the inclusion criteria and both investigated the effect of adult education classes on the online health literacy of participants. Results indicated an improvement in self-efficacy for online health information seeking, health information evaluation and the number of times patients discussed online information with a healthcare provider. Results of both the studies were consistent, in that the intervention showed to be effective. However, the quality of evidence must be downgraded by the fact that only two studies could be included. The review highlighted that the body of evidence to evaluate interventions in this area is weak despite the growing use of online health information by consumers. The authors detailed the need for well-designed and rigorously conducted randomised controlled trials to provide robust evidence in the area.

A more modern review [135] conducted in 2014 highlighted how the lack of rigorous research has continued. Lee et al [135] found few reports of interventions to assist health consumers to find reliable health information online. The review included seven studies which attempted to assist users to access reliable online health information. Only two were RCT's, one of which had been included in Car et al's [134] prior review. Many of the studies used an interactive work shop design to train individuals to search for online health information. One study designed and trailed a health literacy curriculum in two middle schools as five-one hour lessons. Another study, within the review, adopted a holistic approach with development of an online portal to house three modules: self-management, health education, and social networking. All studies within the review demonstrated either positive significant, or positive but non-significant outcomes. No study reported any worsening of outcomes from

baseline/pre-intervention. However, the papers within the review presented several design limitations, including small samples and the use of descriptive analysis. Outcomes were predominantly assessed via self-reported pre-post measures, which have greater potential for bias.

Other reviews [136] have focused on the ability to provide older adults with the skills and knowledge necessary to benefit from eHealth resources. Of the 23 included studies in Watkins et al's [136], 14 were based in informal learning settings (e.g., public libraries or senior centres), four studies in clinical settings, four were administered remotely via ICTs including three by telephone and one by tablet computer. One study involved an intervention carried out via broadcast public service announcements on radio and television. Most of the eHealth interventions used instructional materials developed and adapted from the National Institute on Aging (NIA). The reviewers highlighted that along with a lack of theory, many of the included studies demonstrated poor research design making evaluation of the intervention outcomes problematic. Most sampled studies used non-experimental, cross-sectional, or quasi-experimental designs that tested a single condition without a control condition. RCTs, which arguably produce the highest quality evidence in health-related research by systematically limiting potential biases were used in only a few studies. The review highlighted a need to develop and assess theory-based interventions applying high-quality research design. Despite this, all RCTs within the review did show significant improvements for outcome measures from pre- to post-intervention in individual's ability, confidence to access eHealth.

Four studies [137-140] included within the review used tailoring in their design which has shown to be promising in health behaviour change interventions [141 142]. Tailoring could be used to adjust intervention content for factors like

participants' computer experience, health literacy, income, educational attainment, age, race, ethnicity, language, or health issues [136]. However, tailoring requires knowledge of specific participant factors which would have to be collected prior to dissemination of information.

Numerous studies [143-148] have focused on the effectiveness of acceptance facilitation interventions for eHealth services. The perceived usefulness of eCBT was found to be higher among individuals who had received a short presentation of the service compared with individuals who had received a control presentation [145]. An intervention study demonstrating the use of an eCBT service showed significant increases in participants perceptions on credibility, expectancy-for-improvement and in perceived likelihood of use [148]. Individuals were more likely to use internet based treatment options for mental illness when they had received short text-based information on the services, compared control counterparts [147]. A RCT attempting to increase the acceptance of internet based treatments for depression showed significantly increased acceptance levels for participants who had been shown a brief informational video [144]. Parents who received a computer-based presentation reported significantly greater improvements in knowledge, perceived helpfulness, perceived benefits and intentions to access computer-based therapies [143]. However, one study investigating internet-based interventions for depression on diabetic patients [146] found no significant difference in acceptance and intention to use for patients that had received an information session. Sub-group analysis showed that the acceptance facilitation intervention was likely to be more effective on female and younger (<59) participants and for those who did not frequently use the internet. This

would suggest that these interventions may need to be tailored to the specific needs of subpopulations [146].

Despite limited evidence and numerous calls for a greater theory driven approach, intervention studies have shown the potential to reduce barriers highlighted within the research. Training, in both a collaborative and personal setting, has shown to have the potential to increase an individual's knowledge, confidence, and ability to access eHealth. Training can also reduce 'fears' surrounding online information and can help sign-post users to reliable sources of health information [149]. Interventions which have provided information on or demonstrations of eHealth services have been effective at increasing the acceptance of the service. This has led to increased intentions to use eHealth. Tailoring offers the opportunity to adjust intervention content for factors such as computer experience and ability, health literacy, age or health issues which can be more effective at increasing the effectiveness of the intervention [141 142]. This process can make use of existing information which is provided nationally and freely available [9].

2.5.3 Increasing eHealth adoption and provision by healthcare professionals

The previously discussed literature has highlighted that there is a large disparity in the provision of eHealth services offered by health organisations. For individuals to be able to effectively use and benefit from eHealth, services must be in place and supported. This review struggled to identify intervention reviews and RCT's specifically focussed on increasing the adoption of existing eHealth services. However, it did identify several reviews which examined barriers (discussed previously) and facilitators to eHealth adoption by

healthcare professionals. Numerous reviews have focussed facilitators of electronic health record adoption by practitioners (e.g. [150-153]), a systematic review by Li et al [154] collated this evidence to identify influential factors to healthcare providers' acceptance of various eHealth systems. The review identified 40 factors which were grouped into seven categories including (1) health care provider characteristics, (2) medical practice characteristics, (3) voluntariness of use, (4) performance expectancy, (5) effort expectancy, (6) social influence, and (7) facilitating or inhibiting conditions.

Several of these factors provide insight into how interventions may be effective at increasing eHealth adoption by healthcare providers. Acceptance of eHealth was higher when the perceived usefulness and perceived ease of use were clear to the practitioner. Perceived usefulness had the strongest impact on health care providers' behaviour intention [155], with perceived usefulness being influenced by the ease of use, end user involvement and IT experience and knowledge. Healthcare providers may lack the adequate computer skills to use eHealth systems or may have had previous negative technology experiences. Support prior and during the adoption of eHealth in the form of training [153], provision of guideline documents [156], and troubleshooting can help reduce these factors. Demonstrating the ease of adoption and potential benefits of the system [157 158] can also lead to increased adoption rates.

A review by Good et al [159] examining the adoption of eHealth technology by physicians identified 74 studies, from which several key facilitators were identified. The review further highlighted the importance of demonstrating the benefits or the utility eHealth, particularly in reducing adverse events such as medication errors and drug interactions [160]. Several studies showed that healthcare professionals with previous experience in using eHealth technology

had more of a positive attitude towards it and were more positive about integrating it into their practice. Training and support was again highlighted as an important facilitator to the adoption of eHealth technology. In some instances, training would need to be tailored to the individual physician's knowledge of the eHealth technology with "on-site experts" who can provide first-line support [161]. Several physicians mentioned that having leadership or a champion encouraged the adoption of eHealth technology [162].

The identification of such facilitators is important because it allows for the implementation of a targeted strategy. Implementers need to consider healthcare professional's perspectives and gain their support by addressing barriers to create an environment where eHealth technology is adopted.

2.6 Summary

Despite methodological issues, research has shown that eHealth has had a positive effect in areas such as smoking, alcohol, weight loss, mental health and long term conditions and has the potential to improve healthcare services.

However, a digital divide exists which can prevent those who are most in need from accessing and effectively using eHealth. Individuals may struggle with several barriers which are likely to remain should effective interventions not take place. There is limited knowledge surrounding the significance of eHealth barriers and limited knowledge of how best to intervene. With eHealth becoming more widespread, there is the potential that the digital divide could widen leading to serious inequalities in healthcare provision. For both social justice and healthcare efficiency it is vital that effective and replicable interventions are designed which can help reduce the digital divide and increase eHealth readiness.

Evidence of effective interventions, from rigorously designed studies, which can help reduce barriers to eHealth is lacking. Therefore, research is required to attempt to design effective and replicable interventions which can help reduce inequalities in eHealth.

CHAPTER 3. METHODOLOGY & METHODS

3.1 Methodology

Across disciplines, and within, there are varying views of what research is and how this relates to the kind of knowledge being developed. As a researcher, it is important to acknowledge that there are different ways of viewing the world and that a selected approach to knowledge is one of many. Paradigms guide methodological decisions and how research is conducted. A paradigm can be defined as an overarching philosophical or ideological stance, a system of beliefs about the nature of the world, and ultimately, when applied in the research setting, the assumptive base from which knowledge is produced [163].

The term ontology concerns what is said to exist in the world which potentially can be discussed. Wand and Weber referred to ontology as a branch of philosophy concerned with articulating the nature and structure of the world [164]. Epistemology can be defined as the nature of human knowledge and understanding that can possibly be acquired through different types of inquiry and alternative methods of investigation, simply, the relationship between the researcher and the reality or how this reality is captured or known [165].

Ontological and epistemological standpoints can vary and these paradigmatic differences have an important influence on study objectives and designs, and thus on the type of knowledge produced from research. As an example a researcher may adopt a realist ontology and hold that there is a real world that exists independently of people's perceptions, theories, and constructions [166]. Alternatively, it can be argued that reality is 'fluid' and elusive and only exists through peoples' claims. These competing ontologies are important because

they influence the assumptions that can be made about what can be known and how a researcher can 'know' reality, the epistemological standpoint.

The positivist paradigm [167], also referred to as the scientific paradigm, believes that the world is external and that there is a single objective reality to any research phenomenon or situation regardless of the researcher's perspective or belief [165]. It assumes that reality is concrete and objectivity is achievable. Therefore, it is possible to adopt a controlled and structural approach to conducting research by identifying a clear research topic, constructing appropriate hypotheses and by adopting a suitable research methodology. The purpose of research in this paradigm is to 'prove' or 'disprove' a hypothesis. Other characteristics of positivist research include an emphasis on the scientific method, statistical analysis, and generalizable findings. Furthermore, positivist research usually adopts a control and experimental group and a pre/test post method [168]. It is an opposite approach to Interpretivism which holds that reality is multiple and relative, knowledge acquired in this discipline is socially constructed rather than objectively determined and perceived. Interpretivists avoid rigid structural frameworks such as in positivist research and adopt more personal and flexible research structures which are receptive to capturing meanings in human interaction [165]. Therefore, the goal of interpretivist research is to understand and interpret the meanings in human behaviour rather than to generalize and predict causes and effects, it is important to understand motives, meanings, reasons and other subjective experiences which are time and context bound [169].

Positivism maintains that the researcher is the observer of an objective reality. From this understanding of ontology, the methodology for observation in natural

science was adopted for social science research. Quantitative methods commonly used by social scientists, such as structured interviews, surveys and self-completion questionnaires, also seek to test hypotheses by quantifying human behaviour, with the objective of creating models that can predict behaviour [170]. Although randomised controlled trials and quantitative surveys may have very different foci and may utilise different tools for testing their hypotheses they are ultimately commensurable within this broad paradigm.

In an observational study design the researcher observes and systematically collects information, but does not try to change the participants being observed. The researcher draws inferences about the possible effect of a treatment on subjects, where the assignment of subjects into a treated group versus a control group is outside the control of the researcher. An example of an observational study is a cohort design. In cohort studies an outcome population is first identified by the exposure or event of interest and followed in time until the outcome of interest occurs [171]. Cohort designs allow for the study of change over time and make it possible to establish a time sequence in which outcomes occur. This design potentially could have been adopted to assess the impact of the rollout of superfast broadband. As the infrastructure rollout was occurring separately to the study it was not possible for households to be randomised between having superfast and not having superfast. Therefore, using a cohort approach, a large sample of households could have been surveyed and then followed over a long period. The use of eHealth could have been compared against the timeline of superfast rollout to draw inferences about the effect of this natural intervention. However, using this approach makes it difficult to control for confounding variables which may influence the outcome. Furthermore, it would not have allowed for the assessment of other

interventions which had the potential to impact eHealth use, which an experimental design could accommodate.

An experimental design allows for the deliberate manipulation of certain factors under controlled conditions to identify causal relationships. The researcher does this by allocating the exposure of interest to a selection of participants prior to following them up. A randomised controlled trial (RCT) experimental design is a comparison method that aims to control for confounding variables and sources of bias which can influence the dependant variable or outcome. The process of randomisation reduces bias by distributing the characteristics of individuals or groups between treatment conditions, ensuring no systematic differences between intervention groups in factors, known and unknown, that may affect outcome [172]. This means that only the treatment condition can explain differences in the dependent variable. The RCT model can allow for the inclusion of a 'natural experiment' arm (such as the roll out of superfast broadband) however this arm is allocated rather than randomised. Natural experiments are conducted in the everyday environment of the participants, but the experimenter has no control and cannot manipulate the independent variable as it occurs naturally [173]. As the superfast arm of the study was a natural experiment, and thus was outside the control of the researcher, it was not possible to achieve true randomisation between arms. Therefore, the method of participant randomisation in this controlled trial was open to systematic bias, as participants did not have an equal chance of being in one group or the other [174]. For this reason, it was appropriate to adopt a quasi-randomised approach. Quasi-randomised methods are most often used when it is not possible to randomise individuals or groups to treatment and control groups [175]. It is often necessary to use a quasi-randomised design where

ethical, political, or logistical constraints, like the need for a phased geographical roll-out, rule out randomisation [176].

Using a factorial design allows for the evaluation of two or more interventions in a single experiment. Individuals or groups are randomly assigned to a treatment group which either receives no interventions or a combination of interventions. Using a factorial trial has potential advantages over a standard parallel-groups design. A parallel design assigns one or more interventions to two or more groups of participants and compares effects between treatment arms [177]. This allows for the effect of each intervention to be assessed separately but does consider the interaction between multiple interventions. A factorial trial can analyse both the separate effects of each intervention and the potential benefits of receiving a combination of interventions.

As discussed, several barriers have been identified which can prevent the uptake of eHealth services, with individuals often experiencing more than one barrier. In these cases, it was likely that a combination of interventions addressing multiple barriers would be more effective. Using a factorial design enabled the assessment of infrastructure, household and GP interventions both separately and in conjunction with each other.

Due to the nature of the Superfast rollout and the GP intervention the study was suited to a cluster design. The implementation of high speed broadband infrastructure took place at 'cabinet' level within postcodes. Known as Fibre-to-the-cabinet (FTTC), it involved fibre optic cables running from the BT exchange to the 'cabinet' or 'junction' on a street, which then connects to households via a copper phone line. Cabinets often serve a large geographical area and affect groups of individuals, naturally created clusters. Any intervention at GP practices also affects groups of individuals, with practices often serving several

postcodes. Intervening at this level and not considering the 'spread' of the intervention is likely to have caused a high amount of contamination between intervention conditions. Household interventions also had (a more limited) potential to contaminate the surrounding area. Potentially an individual could have discussed information they received or shared their booklet with a neighbour.

In cluster trials groups of participants, as opposed to individual participants, are randomised to intervention conditions. Cluster sampling involves selecting a sample based on specific naturally occurring groups (clusters) within a population. The population is divided into groups (clusters) and a random sample of these clusters is selected. Geographical clusters are the most common cluster example. A cluster design can be advantageous in studies where interventions cannot be directed towards an individual or where there is a high chance of contamination between individuals [178].

However, the selection of an entire cluster can often produce large samples which can be overly-expensive and time consuming. The use of single-stage cluster sampling, selecting all households within a postcode, would have produced an unmanageable sample size. Practically and economically it would not have been feasible to administer a measure and intervene at each household. In addition, the large difference in rurality of Cornish postcodes would have produced significantly different cluster sizes. This would have created a large disparity between the number of rural and urban households sampled and potentially led to uneven intervention groups.

To overcome these issues a two-stage cluster sampling method was adopted. Two-stage cluster sampling added an additional 'sampling layer'. Clusters were sampled in the first stage. Then as a second stage, simple random

sampling took place separately in every cluster to select a subset for the cluster to be included in the sample [179]. Two-stage sampling can reduce the sample size and produce even sized clusters.

Clustered samples are not as statistically efficient as simple random samples. Similarities among subjects in clusters can reduce the variability of responses from a cluster compared with those expected from a simple random sample [180]. This similarity can be expressed by the intracluster correlation coefficient (ICC). The ICC is a measure of the relatedness of clustered data. It accounts for the relatedness of clustered data by comparing the variance within clusters with the variance between clusters. The ICC must be considered when determining an effective sample size and in the analysis of any clustered study.

3.2 Aims

The study aimed to assess the impact of three interventions (i) improvement of physical infrastructure (Superfast Cornwall); (ii) tailored booklets to households providing information to help improve personal skills in eHealth; and (iii) discussions with GP practices to encourage greater use of the internet in health service provision.

3.3 Methods

3.3.1 Study Design

A pragmatic, cluster, factorial, (2x2x2) design, quasi-randomised controlled trial was used to assess the effect (singly and in combination) of each of the three interventions. One of the intervention arms (superfast broadband) was a natural experiment and so was not possible to randomise this arm but allocated by reported status at the start of the study. The main form of data collection was a

'before' (baseline survey) and 'after' (follow-up survey) measure conducted on households within the sample. This measure used a modified version of the Patient eHealth Readiness questionnaire (PERQ). Additional data collection involved the recording of online services offered via GPs' websites. The cost of interventions was also recorded. Figure 1 provides a visual outline of the study

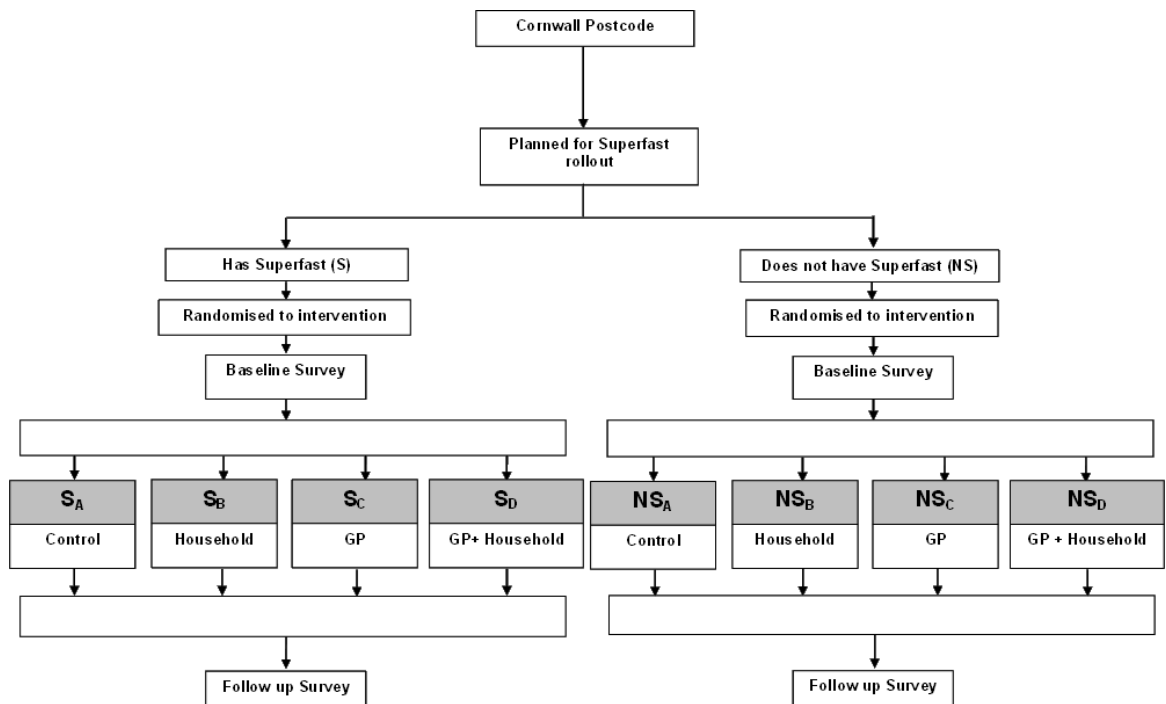


Figure 1. CONSORT diagram of study

3.3.2 Interventions

The intervention process is discussed in greater detail in Chapter 5.

3.3.2.1 Intervention A. Implementation of Superfast Broadband

It was not possible for the study to allocate postcodes to receive or not receive superfast broadband. This process was under the direction of Superfast Cornwall; therefore, this arm of the study was a 'natural experiment'. Clusters were categorised into areas with or without superfast, based on the rollout at the time of sampling. This is discussed within the sampling method.

3.3.2.2 Intervention B. Household Intervention

Participants randomised to the household intervention arm of the study received a tailored eHealth information booklet in the post. Booklets were constructed based on existing documents available from national services and charities.

As the study was a cluster Quasi-RCT, it was necessary to intervene at the cluster level. Therefore, the entire postcode (cluster) received an eHealth information booklet. This process meant that for each intervention cluster two sub-groups occurred:

- 1) Responders to the initial survey
- 2) Non-responders and households not randomly selected to complete the survey.

Responders to initial survey

Responders received a tailored eHealth booklet based on their answers to the initial survey. This booklet was addressed to the individual who completed and returned the survey. This process was designed to identify the needs of an individual and then tailor an informative booklet to help address their needs. For example, a non-internet user reporting that they would use the internet more for health if they could get someone to help them received a booklet showing resources in their area that assist a person in using the internet, such as UK online centres. On the other hand, a home internet user who reported that they lacked confidence in using the internet received information about online based internet training, such as Learn My Way. Creation of tailored booklets used a decision tree to identify which information to include in the booklet. Information was in the form of A5 'booklet pages'.

Non-responders and households not randomly selected to complete the survey

Where Patient eHealth Readiness Questionnaire (PERQ) data was not available, it was not possible to identify the individual needs of the household and tailor at this level. These households received a generalised booklet constructed using the same information sources used in the personalised booklets (A5 pages). Tailoring for these households could only use geographical data, for example showing a person what is available in their area based on their postcode. The booklet was addressed to the household as opposed to an individual.

3.3.2.3 Intervention C. GP Intervention

An intervention was conducted at the GP level. This intervention had three steps:

- (i) The researcher contacted the selected practices to arrange a meeting. This written contact explained the project and attempted to arrange a meeting to discuss use of eHealth services by the practice.
- (ii) At this meeting GPs were given suggestions as to how they might expand from their current use of eHealth services to use additional eHealth services available to them and what other GPs in their area offer.
- (iii) A tailored booklet for the practice was produced to accompany the researcher's visit. The booklet was designed to inform the practice about which eHealth services were available to them, the potential benefits of adopting these services and how they might be implemented

A data log was kept describing the process of the GP intervention including responders/non-responders and the reaction to the intervention. GPs websites were assessed before and after the intervention.

3.3.3 Sampling method

A sampling method was designed to reduce potential contamination between the eight arms of the study and to account for the rollout of Superfast Cornwall. Due to the nature of the rollout, certain postcodes within Cornwall were already superfast enabled before sampling took place. BT, the company responsible for the rollout, was not able to provide accurate predictions of the timings of the future rollout across the county, this was due to confidentiality concerns regarding which towns should be enabled earlier in the process. Due to previous negative news coverage BT would not commit to precise rollout details. This meant that areas of Cornwall which would remain 'Non-superfast' for the duration of the study could not be identified.

Intervening at practice level introduced the likelihood of contamination between intervention groups. GP Practices often serve a large geographical area; any intervention at this level would affect several postcode clusters. This meant that random selection of postcodes, without accounting for the intervention area, would likely allocate postcodes with shared practices to separate intervention groups.

The sampling method sought to reduce the likelihood of contamination by eliminating postcode clusters at the practice level. This was achieved by identifying shared practices based on geographical distances with the use of ArcGIS mapping and spatial analysis software.

3.3.3.1 Creating the data set in ArcGIS

A spatial map of Cornwall county, excluding the Isle of Scilly, was created in ArcGIS using Ordnance Survey (OS) mapping data obtained from EDINA Digimap. The OS data contained a total of 20088 postcodes (see Figure 2).

GP Location Data

The location of GPs in Cornwall was obtained through NHS choices data. This data listed the longitude and latitude of all GPs in the UK. GPs within the county of Cornwall were added to the map. In addition, all GPs located along the Cornish border were also added as some Cornish postcodes had their closest GP outside of Cornwall.

Superfast Data

Superfast rollout data was provided by Superfast Cornwall on the 18/03/13 detailing the fibre coverage at that time. This was reported at the cabinet level, with some postcodes containing multiple cabinets. Cabinet coverage within a postcode was summed to create a single coverage percentage per postcode. Postcodes with a coverage $\geq 50\%$ were classed as 'Has Superfast'.

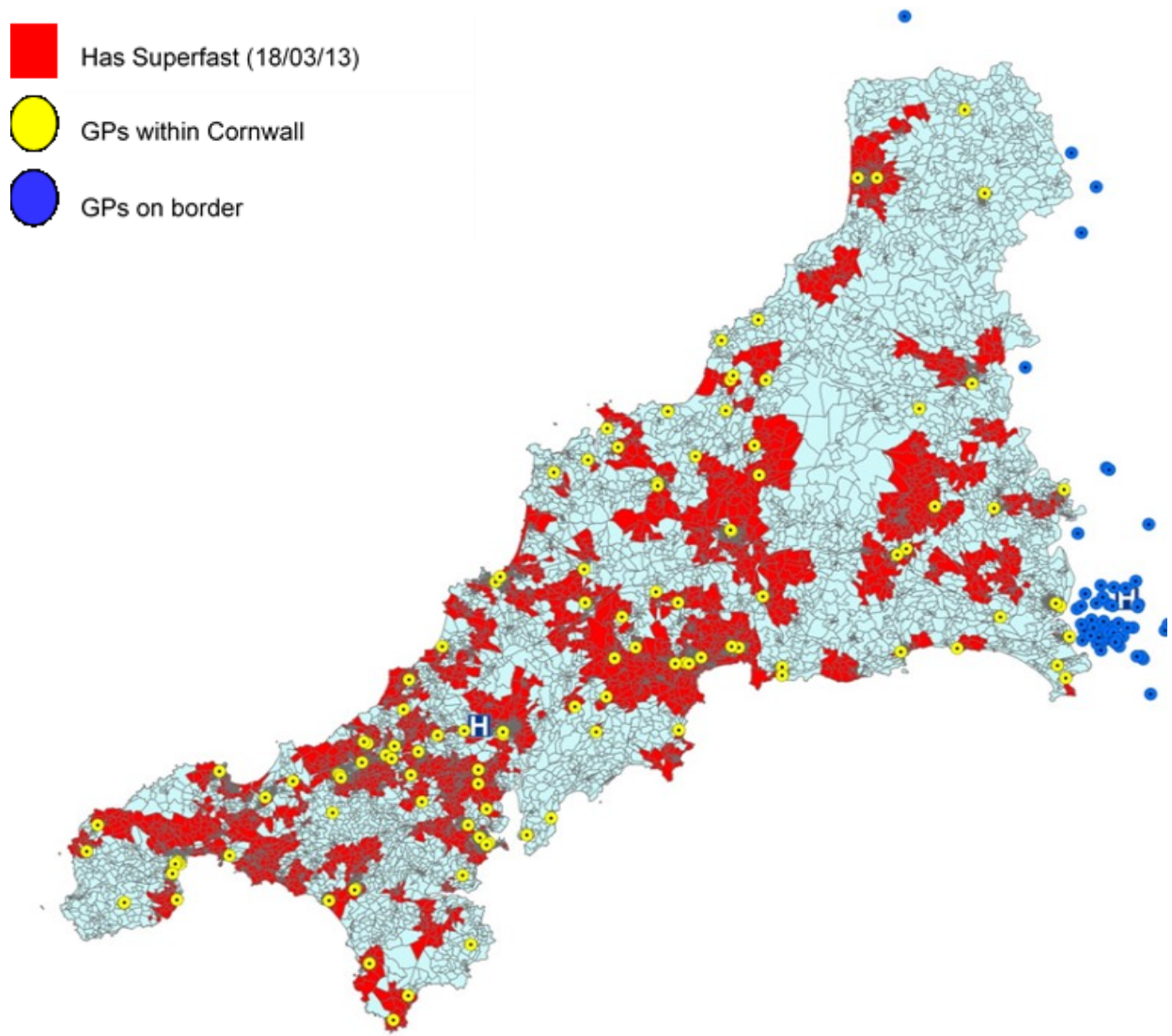


Figure 2. Map Created in ArcMap using GP and Superfast data

Calculating closest GP

The closest GP for each postcode was calculated by creating a centroid, centre point, for each postcode. The centroid of each postcode was then compared to each GP location using the 'Near' function in ArcGIS. This calculated the straight-line distance between the centres of the postcodes to surrounding GPs, obtaining the closest GP for each postcode. This information was stored against each postcode.

Population Data

Population data for postcodes was obtained from the 2001 census. This information was 'joined' to the map against each postcode. Population data served to provide a limited representation of the population density for each postcode.

3.3.3.2 Cluster selection

The previously described process in ArcGIS had created a database containing; the closest GP, superfast coverage, and population. These variables were listed for each postcode in Cornwall. The database was exported to Excel format creating a spreadsheet of the 20088 postcodes.

Figure 3 (Page 66) provides a visual representation of the entire cluster sampling process; this process is further detailed below.

Postcodes listed as having a population of zero, or where no population data was present, were eliminated from the sample leaving a total of 17130 postcodes (2958 eliminated).

The remaining postcodes were then allocated into two separate lists based on their Superfast coverage. This allocation did not include a form of randomisation as the research had no control over Superfast rollout.

Has Superfast (S): Postcodes with coverage $\geq 50\%$

Did not have Superfast (NS): Postcodes with coverage of 0%

Postcodes with Superfast coverage between $0-49\%$ were removed from the sample to allow for a greater difference between groups, (745 were removed). This left a total of 16385 postcodes, in two groups (S=8000, NS=8385) both of which were sorted in descending order based on the population of the postcode.

The following process of selection then took place until no postcodes remained:

1. A randomisation took place to identify which list (S, NS) would be selected from first

This randomisation was in the form of a random number generator in excel. An even number would mean a selection from the has superfast list, with odd indicating selection from the non-superfast list.

2. The first postcode (highest population) from the list (S, NS) was selected and was randomly allocated to one of four groups (SA-SD / NSA-NSD).

Selecting the 'top' postcode of the resulting list introduced potential ordering bias into the selection of postcodes. Postcodes with lower populations had less chance of being included in the study where another higher population postcode shared the same GP practice. After selection, random allocation did occur, meaning selected postcodes had equal chance of receiving interventions under the control of the researcher.

- 3. Any postcode which shared the same geographically closest GP Practice as the selected postcode was then eliminated.**

Eliminating postcodes with shared GPs reduced the high chance of contamination between arms. However, as discussed, this elimination introduced a selection bias as low population postcodes had a lower chance of being selected.

- 4. The remaining top postcode on the second list was then selected and randomly allocated to one of the four groups (SA-SD / NSA-NSD).**
- 5. This process was repeated from step one until no postcodes remained on either list.**

As a result of the sampling method a total of 78 postcodes were selected and randomly allocated to one of the four intervention groups within their level of superfast coverage. True randomisation for all aspects of sample selection was not possible due to the natural superfast arm, however the sampling method was able to randomly allocate selected postcodes between interventions under the control of the researcher.

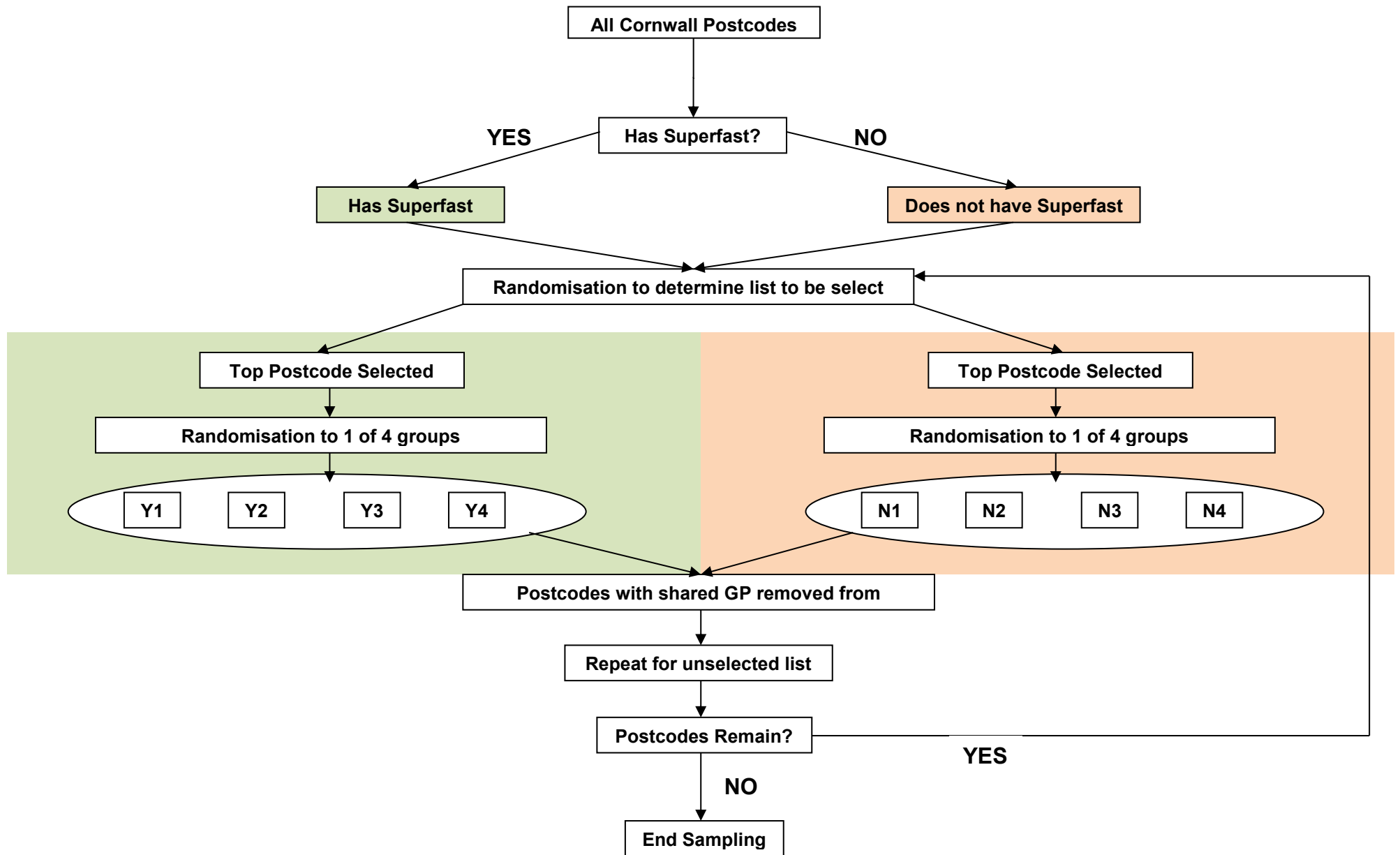


Figure 3. A visual representation of the sampling method

3.3.3.3 Household selection

The number of households within each of the selected postcodes was obtained using the Zoopla website service [181]. The number of households per postcode ranged from 10 to 101 with a mean of 62. Due to the large variability in size, a total of 18 households per postcode were randomly selected. This served as an attempt to keep clusters the same size, to ensure a similar amount of both rural and urban households. Furthermore, for practical reasons, it kept the selected sample to a feasible size for the design of the study.

In postcodes with less than 18 households all households were included in the sample.

3.3.3.4 Selected Sample

The described method produced a total of 1388 households from 78 postcodes across Cornwall (slightly less than 78X18). The average superfast coverage was 99% in the 8000 superfast enabled postcodes. Average property values (Zoopla 2013 data) ranged from £62,638 to £515,886 per postcode. The average number of people per household was 2.45 (using Zoopla household data and census population data). Nearest GP distances ranged from 0.05 to 5.13 miles. No two clusters shared the same GP practice.

3.3.3.5 Sample Power

As sample size was limited for feasibility and by number of unique GP practices, a sample size calculation based on the desired magnitude of effect was not conducted. Instead a calculation was made to estimate the possible magnitude of effect that could be found with 80% power using the equation:

$$\mu_1 - \mu_2 = \sqrt{\left(\frac{\left((Z_{(\alpha/2)} + Z_{\beta})^2 (2\sigma^2) (1 + (M - 1)\rho) \right)}{N} \right)}$$

Where ρ is the intraclass correlation coefficient calculated from the initial PERQ study, using the equation:

$$ICC = \frac{(MS_{bet} - MSe)}{(MS_{bet} + N - 1 \times MSe)}$$

Assuming a 50% response rate the calculation estimated that the smallest effect size that could be found between the two arms of 'has' and 'does not have' superfast was 0.52 assuming 80% power and 95% significance. The smallest effect size that could be found between each of the eight arms of the study was 1.05 with 80% power and 95% significance.

3.3.4 Outcomes

3.3.4.1 Primary Outcomes

eHealth readiness and eHealth inequalities

eHealth readiness includes (i) patients' perception of eHealth provision, (ii) their personal ability and confidence in using eHealth, (iii) their inter-personal support, and (iv) their perception of relative costs. These were measured using a modified version of the PERQ. Responses to questions in the PERQ were combined into an overall 'readiness' score. The standard deviation of the scores represented eHealth inequalities. Therefore, reductions in the standard deviation of Readiness scores indicated a reduction in eHealth inequalities.

3.3.4.2 Secondary Outcome

Health related miles travelled

The PERQ recorded the number of journeys and method of transport to GPs and Hospitals in the previous year. Total miles travelled was calculated by using Google Maps to estimate the driving distance to nearest GP and Hospital and then multiplying by the reported number of journeys.

Cost Analysis

The cost of interventions was estimated using data recorded on the development and implementation of household booklets and by interventions with GPs. Cost savings and expenditure by participants were estimated using response data from the initial and follow-up PERQ.

3.3.4.3 The Patient eHealth readiness Questionnaire (PERQ)

The initial PERQ was designed as “self-completed questionnaire and scoring system to assess eHealth readiness and, by examining the spread of scores, eHealth inequalities” [70]. The PERQ went through a total five iterations, including a trial with colleagues, to create the baseline survey (Appendix C).

3.3.4.4 Modifications to the PERQ

Following the creation of the initial PERQ and completion of its pilot, Jones [70] identified several areas which could be modified or improved upon. Comments from the author included:

“There were some ceiling effects on Personal score..... there was still a large minority (51 (15%)) of the sample with maximum scores, being able to do all four internet tasks and being totally confident in their use of the internet”, “The second part of section F probably did not collect particularly useful information and given the desire to shorten the questionnaire could possibly be dropped in further developments”, “The support section of the questionnaire was the least successful. This had proved difficult throughout piloting. We had sought ways of getting those people who had never needed or sought help to answer the questions by wording the questions about ‘people in general’, and by stressing that we wanted everyone to answer this section. Nevertheless, 21/271 (7.8%) internet-users failed to answer this section.”

Considering the authors comments, the PERQ was modified in various ways. To counter ceiling effects on personal scores examples of harder tasks as well as health related tasks were added to grounding questions. Section F was merged with section E to shorten the questionnaire. Formatting throughout was changed and some sections were reordered to increase clarity.

The largest modification was to split and colour code the questionnaire into two separate versions to increase simplicity for the responder. This created an 'internet user' version on green coloured paper and a 'non-internet user' version on pink coloured paper.

3.3.4.5 Additions to the PERQ

Content additions were included to develop the PERQ for the study. Many of these additions were included in the Section "About you and health information and support". As the study sought to assess change over an 18-month period it was necessary to capture the name of the responding individual to enable a follow-up questionnaire to be addressed to that person.

A question asking the responder to estimate the distance to their GP was added as a basic check to identify if responder was a member of the closest GP practice identified in the sampling procedure.

Questions asking for the estimated number of visits to GP and Hospital over the previous year were added to allow for a calculation of total travel distances. To establish the method of transportation used for both GP and Hospital visits a question from the NHS National Kidney Care Patient Transport Audit 2010 [182] was edited and included.

A question asking if the responder had received a booklet in the past six months regarding using the internet for health was added. The question was designed

to establish (i) if, in the baseline survey, any external source had previously contacted the individual regarding eHealth services, (ii). the responder's memory of the tailored intervention in the follow-up survey.

Finally, a unique ID was added to the top of each PERQ which corresponded to individual households and enabled the identification of the participant's cluster and intervention group.

3.3.4.6 Online version of PERQ

An online version of the PERQ was created to add an additional response method for participants in the hope that it would increase the response rate of the study. The online questionnaire was a direct copy of the 'internet user' offline version. SurveyMonkey [183] was used to create and host the questionnaire for the duration of the study.

To ensure that no bias would be introduced based on response method a trial was conducted on a convenience sample of 20 participants, friends and colleagues, in a repeated measure design. This indicated that there was no such bias.

3.3.5 Ethical considerations

3.3.5.1 Ethical approval

Ethical approval for the baseline survey was obtained from Plymouth University Faculty of Health, Education and Society ethics committee on the 18th of June 2013 (Appendix D).

Further ethical approval for the intervention process and follow-up survey was obtained from the Faculty of Health and Human Science on the 9th of July 2014 (Appendix E). The study did not require NHS REC approval (Appendix F) but

did obtain local research and development approval from the Royal Cornwall Shared Research Management Service on 18th of August 2014 (Appendix G).

3.3.5.2 Informed consent

Informed consent was determined for both the baseline and follow-up survey by the completion and return of the PERQ. Due to the cluster design all interventions took place at the cluster level. Therefore, entire postcodes received the eHealth information booklet. Many households within intervention postcodes were either not randomly selected to complete the PERQ or were non-responders. These households did not provide explicit consent to receive the intervention booklet in the post; however, they were under no obligation to read the booklet or visit URL's listed in the booklet. No individual research data was collected on these households.

Households who explicitly refused the baseline survey did not receive intervention booklets, this was classed as a withdrawal of consent for the project.

3.3.5.3 Confidentiality and Anonymity

The PERQ captured the name, age, gender and address of respondents. The name of a respondent was required to address future contact, such as the follow-up PERQ and intervention booklet. An Excel database listed the selected delivery addresses alongside a corresponding unique ID. On return of the PERQ the name of the responder was entered into an additional column, storing participant name against address. This database was used solely for informing participants if they had 'won' a voucher or for addressing the intervention booklet and the follow-up PERQ using the mail merge function.

Responses to PERQ questions were stored in a separate Excel database for analysis. Responses were stored solely against a unique ID. Both databases

were separately password protected and stored on a password protected computer. Therefore, to match named data with responses or specific household addresses, would have required three separate passwords. No named data was accessible outside of the research team. All hard copies of returned PERQs were kept in a locked cabinet and destroyed upon completion of the data analysis.

Contact details of GPs and practice managers were obtained via practice websites and were therefore already in the public domain. However, to preserve the anonymity of intervention practices the names and locations against individual results were not discussed. GP notes were recorded against unique IDs and used a similar password protected Excel database to match practice name against location.

CHAPTER 4. BASELINE SURVEY

4.1 Sampling frame

The sample comprised 1388 households from 78 postcodes across Cornwall were included in the baseline survey. Figure 4 shows the 'spread' of selected postcodes.

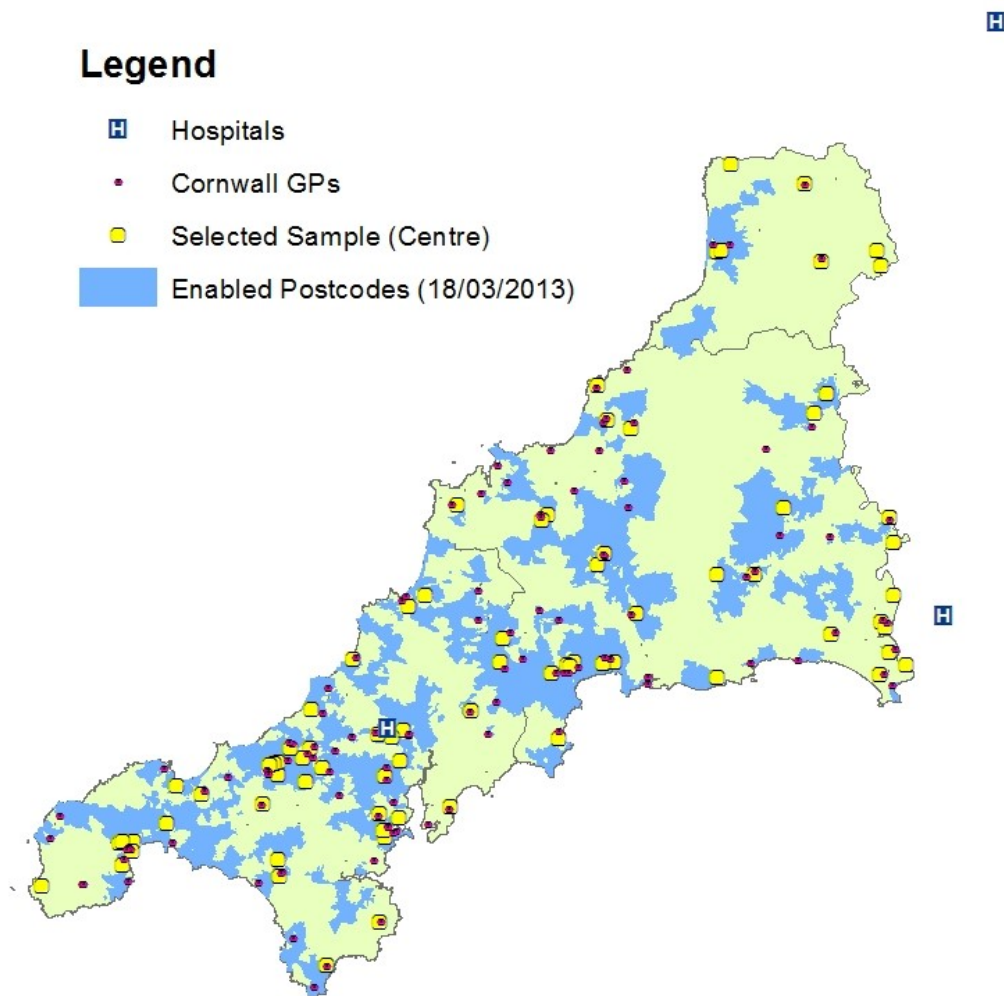


Figure 4. A map of enabled postcodes within Cornwall on 18/03/2013

Each household received a baseline survey 'pack'. The pack contained a covering letter (Appendix H) explaining the research and with instructions for the survey to be completed by a member of the household aged 16+, whose

birthday was next in the household; this added a further level of random selection. The pack also contained a pink PERQ for non-internet users and a green PERQ for internet users. The green PERQ listed the URL of the online version of the questionnaire. Finally, a pre-paid envelope was included for responses. Responders were offered an incentive in the form of entry into prize draw for £20 M&S vouchers with a 1 in 50 chance of winning.

In the hope that it would increase the response rate the researcher attempted to hand deliver the baseline survey to each of the 1388 households. If someone was home the researcher explained the purpose of the survey and reiterated the need for the questionnaire to be completed by an adult whose birthday was next in the household, regardless of their age (16+) or use of the internet. The researcher also offered to answer any questions the person may have. For households where no one was home, the baseline pack was posted through the door. In cases where it was not possible to locate the household, the pack was placed into the post to be delivered by the Royal Mail. Non-responders, after a month, were sent a reminder pack which contained an additional letter detailing the research and explaining why a response was important.

Delivery to an initial 144 households from 8 postcodes commenced in the final week of August 2013. This served as a final 'trial' to ensure that no major errors in survey instructions or return method were present. The remaining 1244 were delivered during the period of mid-September to October 2013 between the hours of 9:30am – 6:00pm. A total travel distance of 1332 miles was covered during the delivery of the baseline survey.

4.2 Results from baseline

4.2.1 Method of delivery

The researcher was able to hand deliver and speak to a member of the household on 460 occasions (33.1%).

825 surveys (59.4%) were hand posted when no household member was present to receive the baseline pack.

75 surveys (5.4%) were posted via the Royal Mail when the researcher was unable to locate or access the household. Of which 17 (1.2%) were returned by the Royal Mail for the reason of 'No such property' which reduced the sample size to 1371.

4.2.2 Response rate

A total of 29 households (2.1%) directly refused to be included in the study.

271 households (19.8%) responded within a month of receiving the baseline pack. The remaining 1071 (78.1%) received reminders in the post. Following reminders, a further 123 (9.0%) households responded, this took the total response rate to 394 (28.7%).

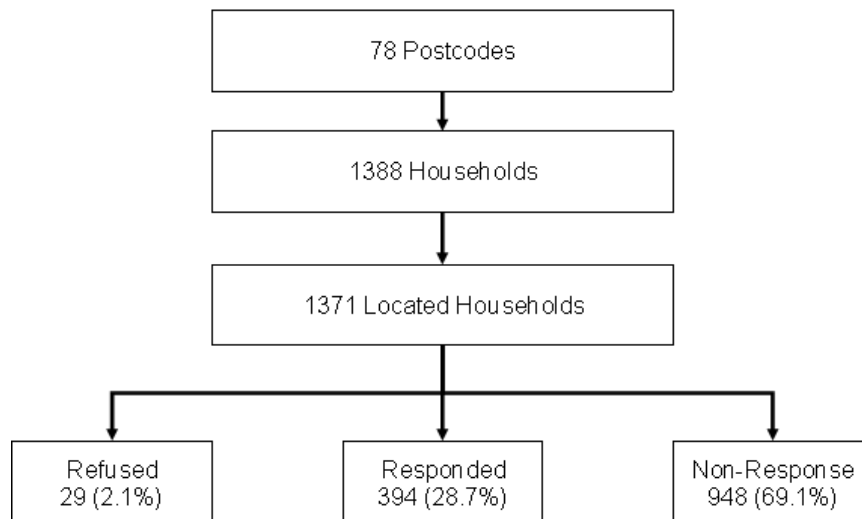


Figure 5. Sample response flow

Households where the researcher could speak to an individual (460/1371, 33.1%) were significantly more likely to return the questionnaire (33.5% vs 27.4%, $X^2=5.4219$, $p<0.01$).

4.3 Demographics of responders

Responders were disproportionately female (252/394, 64.0% female vs 131/394, 33.2% male, 11/394 2.8% gender unknown) and older (58.8% aged 55+) than the population of Cornwall. House price values ranged from £71,835 to £515,507 with an average of £202,365 (Zoopla data). The 394 responding households had higher estimated values than those with no respondent (£202,365 versus £186,778; $t(1342)=3.34$; $P<.001$).

4.4 Internet use

Personal use of the internet over the previous three months was similar to national statistics (306/394, 77.7% vs 78% from Oxford Internet Survey 2013 Report [5]). Most internet users used the internet at home (288/306, 94.1%) on

a mobile device (166/306, 54.4%) or at work (87/306, 28.4%) and used the internet at least once a day (252/306, 82.6%).

The most common reported uses of the internet were; to find information (e.g. Google) 95.4%, email 92.1%, social networking 61.8% and to watch videos 51%. Figure 6 shows the frequency of internet use across each of the categories.

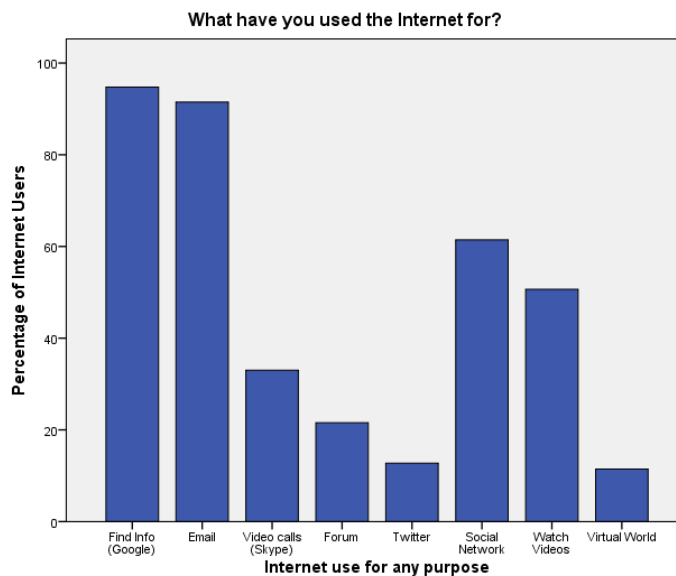


Figure 6. Response to 'what have you used the internet for?'

Most internet users (81%) reported that their internet connection was fast enough for their needs with 15.7% reporting that they had an internet connection which was too slow for their needs. The most common reason listed for this was that they 'lived in a rural area which did not provide a good connection to their home' (38.6%).

4.5 Health related internet use

Over half of internet users had used the internet for health-related activity (210/310, 67.7%) mainly searching for health information (200/210, 95.2%) with fewer respondents using e-mail (36/210, 17.1%) and discussion forums (26/210, 12.4%).

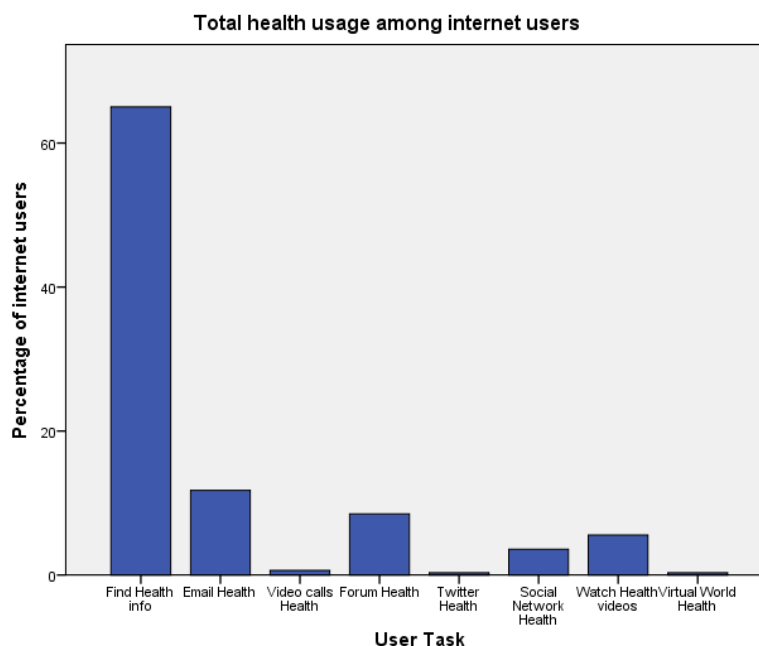


Figure 7. Total usage among internet users

Only 42.4% (129) of internet users reported that their local GP surgery had a website which they had viewed, with just over half of these (54.3%) reporting that they had used the website or email to order a repeat prescription. A further 10 (7.9%) reported that they had booked a GP appointment online with two listing that they had access to their medical record online (1.6%). The most common response in these two categories was 'Don't Know' (54.8%, 75.8%) potentially indicating a lack of provision or promotion of these services by local GPs. This is more apparent considering only 18% (55/306) of all internet users reported that a doctor, nurse, or other health professional had ever given them information to help them use the internet for their health.

Internet users were quite confident at using the internet for health-related tasks ($M=7.44/10$, $SD=2.6$) with 65% selecting the statement 'I have or would use the internet for health and have no real barriers to that use' to sum up their feelings of eHealth. Of the remaining, the largest perceived barrier to eHealth was the lack of online services available (14.6%).

4.6 Non-internet users

Non-internet users, individuals who had not used the internet in the past 3 months, accounted for 22.3% (88/394) of the sample. Most of these (85.1%) reported that they had never personally used the internet, with just 2 responders (2.3%) reporting that previously used the internet often before stopping. Over half had another person use the internet for them (51/83, 61.4%). Despite the lack of personal use, 27.2% (24/88) reported that their home had an internet connection.

Non-internet users were disproportionately older compared to internet users ($\chi^2=100.786$, $p<.001$, Figure 8) with no responder under the age of 45 reporting non-use. The rate of non-use appeared to increase as age increased.

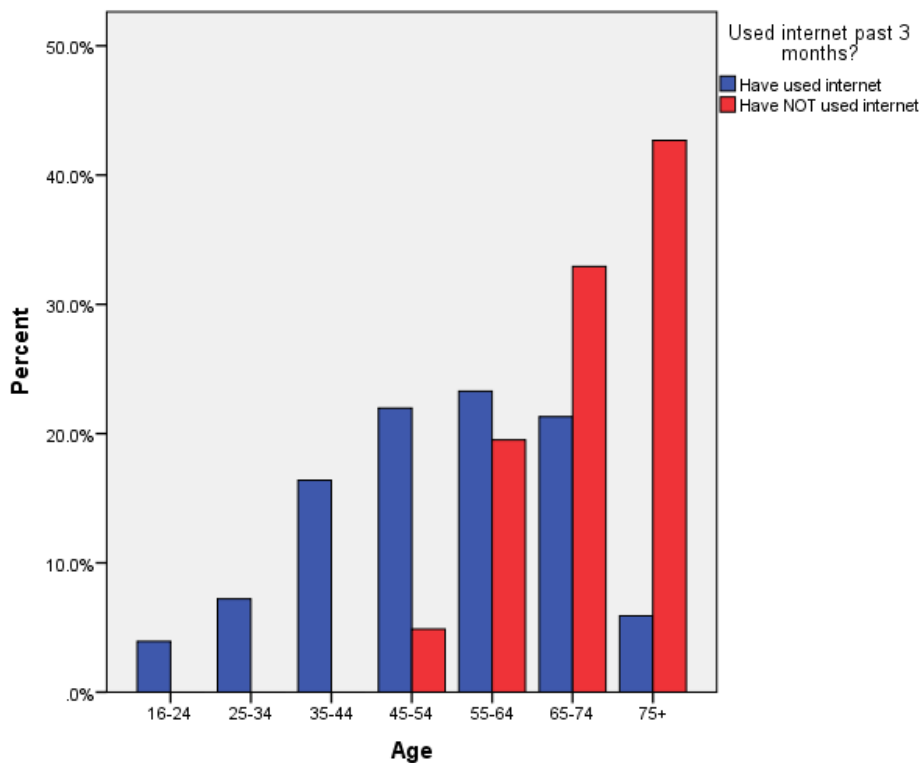


Figure 8. Age distribution between users and non-users

Most non-internet users reported having no interest at all in using the internet, with over half (56.3%) selecting this option to ‘sum up’ how they felt about eHealth in general. This highlights the potential difficulty in attempting to reduce the digital divide due to the large lack of interest among non-users.

Furthermore, only 5 (6.3%) indicated that they would be willing to use the internet if either, money was no object, they could get a good internet connection or if more services were available to them.

4.7 eHealth readiness

As previously discussed (Chapter 3) the PERQ was modified in various ways to consider comments following its initial pilot and to add additional questions.

The changes to the PERQ meant that the original SPSS syntax had to be edited to ensure that the modified measure generated accurate eHealth Readiness

scores. Many these changes were variable name changes which had no effect on the construction of eHealth scores. In some areas, where questions had been added or modified, changes were made to the calculation of scores in keeping with the original syntax.

Twenty-two households had missing data in certain areas which prevented the calculation of a Readiness score. This left a remaining 372 (94.4%) with 'complete' data. Readiness scores ranged from 0-7 with an average of 4.28 and standard deviation of 1.82.

To ensure that the modifications to the PERQ scoring had not significantly altered generated scores, Readiness scores were compared against Jones' [70] pilot data. There was no significant difference between Jones [70] and the baseline Readiness scores (4.24 vs 4.28, $t(703)=-0.29$, $p>0.05$) or the standard deviation of readiness (1.73 vs 1.81, $F=0.57$, $p>0.05$).

4.8 Health related travel

4.8.1 Estimating distances to GPs

During the sampling process nearest GPs were calculated in ArcGIS using the straight-line distances between the centres of postcodes to surrounding GPs, selecting the smallest distance to identify the closest GP. Straight line distances were used at this phase to accommodate for the vast number of postcodes in the sampling frame (20088). With the final sample selected and incorporating a manageable size of 78 postcodes, it was possible to conduct more accurate distance calculations using route analysis. Google Maps was used to conduct route analysis on each of the postcodes by calculating a car drive or walking route from a postcode to its previously identified nearest GP.

Distances calculated in the sampling method were strongly correlated with Google Map distances ($r=.84$, $p<.001$). As expected distances were higher than those calculated in the sampling method (1.48 vs 0.87 miles, $t(393)=10.3$, $p<.001$). The process of obtaining route distances highlighted that for 3 postcodes the identified nearest GP was located across a body of water leading to significantly greater travel distances. In these cases, it is possible that the previously identified closest GP did not actually serve the sampled postcode, it is less likely that responders from these postcodes visited the sampled GP.

Responders were asked to estimate the distance to their GP, this was compared to the calculated route distances as a final consistency check to examine if the sampling method was accurate at obtaining a postcode's GP.

Figure 9 shows the mean calculated route distances compared to the categories of households' responses. Mean calculated route distances increased as household estimates increased, which lends some validity to the GPs identified in the sampling method.

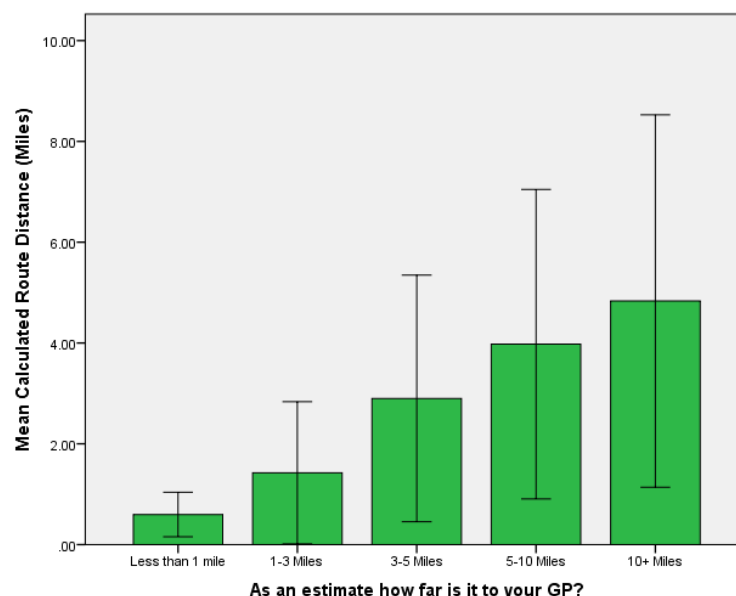


Figure 9. Mean calculated distances compared to responders' estimates

4.8.2 Health related travel

Responders number of visits to their GP in the previous year ranged from 0 - 150, with a total of 2004 (n=386, M=5.19, Median=3). Most (75%) reported visiting their local GP on five or fewer occasions over the year, with two visits as the most frequent response. Most households (60.4%) used their own vehicle to drive to the GP, with fewer walking or cycling (27.5%) and smaller numbers getting a lift from family or friends (6%), using public transport (3.9%), taxis (1%) and other (1.3%).

Total travel miles was calculated using the following equation for each responder.

$$\text{Total Travel Miles} = (\text{Number of GP visits} \times \text{Distance to GP}) \times 2$$

The multiplication by two assumed that a person would make a round trip to their local GP, returning home after a visit.

Responders travelled a total of 4882.9 miles visiting their GP in the year prior, with an average of 12.65 miles per household per year. The amount of 'car miles' travelled to GP was calculated using responders who reported either using their own vehicle, a friends or families' vehicle or a taxi to visit their GP (n=260). Driving households travelled a total of 4124.1 car miles in the previous year, as expected these households travelled further on average when compared to 'Non-driving' households (15.9 vs 6.0 miles, $t(384)=4.52$, $p<.001$).

Carbon emissions of car travel was calculated using the Department of Transport's new car carbon dioxide emissions vehicle statistics data. This provides the average grams of CO₂ per car mile travelled of newly registered cars since 2002. The measurement of 230 grams CO₂ per car mile was used (average of cars registered in 2010). Car miles visiting GPs created an

estimated 948.5 kg of CO₂ over the previous year for the 260 driving households, an average of 3.6 kg per household.

4.9 Intervention arms

4.9.1 Response rate

The sampling method was successful in producing similar response from 'Has Superfast' and 'Does not have Superfast' areas (195, 49.1% vs 201, 50.6%).

Response rate between the 8 study arms was also evenly spread with no significant difference in group size ($X^2=2.747$, $p>0.05$, Figure 10).

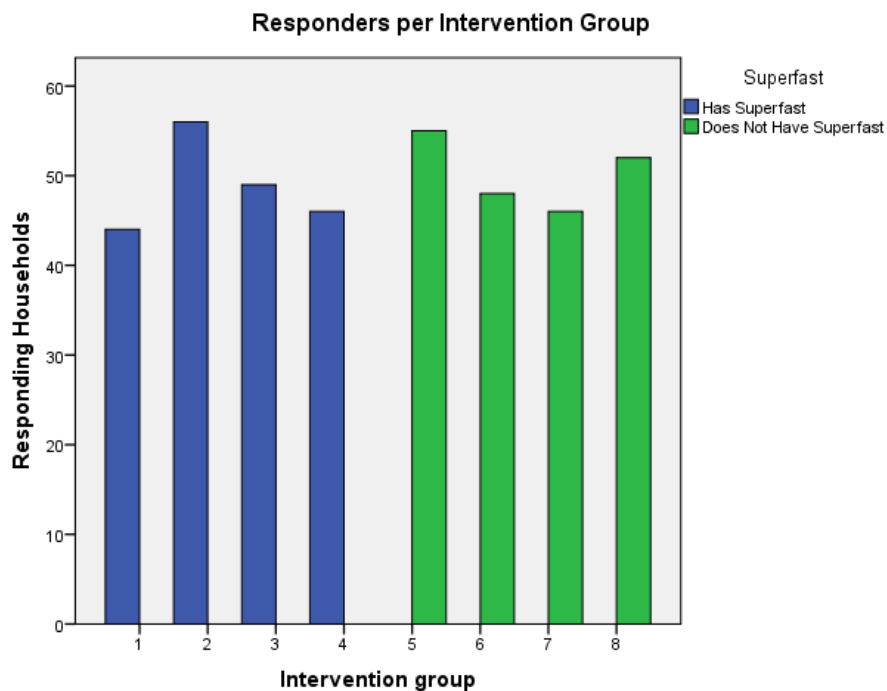


Figure 10. Response per intervention group.

4.9.2 Demographic differences

Demographics of intervention arms were compared to highlight any differences which could potentially cause bias. This comparison showed significant differences in estimated property values between arms ($F(7,385)=3.978$, $p<.001$), post-hoc tests revealed that group three had significantly higher values

compare to groups one and eight. Furthermore, group 8 contained a higher proportion of under 45 year olds when compared with other groups ($\chi^2=16.21$, $p=.001$).

4.9.3 Superfast vs Non-Superfast

Superfast areas had significantly higher perceptions of internet speeds when compared to non-superfast areas. With 89% of superfast responders reporting having 'an internet connection that was fast enough for their needs' compared to 73% in non-superfast areas ($\chi^2=10.942$, $p=.001$). This indicated a potential early effect of the superfast rollout and lends some validity to the sampling method at categorising superfast and non-superfast postcodes.

There was no significant difference in the proportion of internet users between superfast and non-superfast areas ($\chi^2=0.633$, $p>.05$).

4.9.4 eHealth readiness

Intervention groups eHealth Readiness scores ranged from 3.87 to 4.54 but did not differ significantly between intervention arms ($F(7,364)=0.91$, $p>.05$).

Further analysis was conducted on the sub-variables which contribute to the creation of Readiness scores (Personal, Provision, Economic and Support), this identified no significant difference between intervention arms in all sub-variables (all $p>.05$).

CHAPTER 5. INTERVENTIONS

As stated in the methods chapter, this study consisted of two interventions which were under the control of the researcher. These arms of the study consisted of a booklet and GP intervention, the following chapter details the design and justification for both interventions.

5.1 Approach

The Diffusion of Innovation [125] helps explain the adoption of technology and can provide insight into why some people choose not to adopt certain technologies. The use of eHealth relies heavily on the adoption of the internet, a prior innovation. The baseline measure identified that over a fifth of responders had not used the internet in the past three months, this population represent the potential 'laggards' of the internet innovation. Laggards tend to decide after looking at whether the innovation is successfully adopted by other members of the social system in the past, often have limited resources and a lack of awareness or knowledge of innovations. Due to all these characteristics, laggards' innovation-decision period is relatively long.

This set of individuals are unlikely to benefit from eHealth without adopting the internet. Analysis of the responses from these individuals highlighted that over half reported having no interest in the internet. Considered in the context of the Diffusion of Innovations, currently during the innovation-decision period, these individuals have formed a negative opinion of the internet and perceive no benefit from its adoption. They 'sit' within the confirmation stage and look for support from their peers for their decision. Rogers [125] stated that this decision can be reversed if the individual is exposed to conflicting messages about the innovation. This would suggest that a tailored approach which

highlights the benefits of the internet, using relatable examples from the individual's peer group, may be effective at reversing this rejection decision.

A further quarter of non-internet users reported that they did not understand the internet that much. These individuals may see the benefit of the internet and may not have made a conscious rejection decision but rather may lack the ability or knowledge of how to use the internet. They perceive the complexity, how difficult the innovation is to use, to be high. The literature review has shown that training can be effective for individuals who lack internet skills [134-136]. However, logistically for a study of this size it was not feasible for the researcher to individually train participants within the study or run several group training sessions across the county. National programs are available [129 184] and can be demonstrated to individuals, other studies have shown that existing resources can be helpful in assisting interventions [136]. Providing examples from others, of similar characteristics, who have learnt to use the internet, can help to limit the perceptions of complexity surrounding the innovation.

Internet users may also struggle from a lack of skills to use the internet which may limit their ability to use and understand eHealth. These individuals can also benefit from training and assistance to use internet and can access online resources designed to improve skills e.g. Learn My Way [185]. Most (65%) internet users reported that they had 'no barriers' to using eHealth, and would potentially not benefit from training designed for simple tasks. It is likely that these individuals would benefit from having increased awareness of available eHealth resources both locally and nationally.

The Diffusion of Innovation can also help explain the spread of service adoption with GP practices. Arguably eHealth innovations at the practice level are still within the early adopter phase. Rogers [125] highlighted how the opinions and

perceptions of early adopters or early majorities can heavily influence the further adoption by remaining members of the social system. GP's will monitor the outcomes of service adoption among their peers and use this knowledge to inform their innovation-decision process. Highlighting the benefits that early adopters have received from using eHealth services may influence the remaining majority to adopt the service. Furthermore, using relatable examples, such as neighbouring GPs, may help to alleviate fears over complexity of service adoption.

5.2 Booklet intervention

Households randomised to the 'Household Intervention' or 'GP & Household Interventions' (groups 2,4,6,8) received a tailored A5 eHealth booklet in the post. This included a total of 2407 households across 39 postcodes. Booklets were constructed using existing documents available from national services and charities. For responders to the baseline survey, the booklet was highly tailored using a decision tree matrix which is detailed within this chapter (5.3). Where response data was not available, tailoring was limited to geographical information. This led to the production of several 'standardised booklets' based on the sampled postcodes location, which is detailed in section 5.4.

5.3 Tailored booklets

5.3.1 Pages database

A 'database' of A5 pages was created using information from national and local services and charities. This database comprised pages to be included as standard in each booklet and additional informative pages to be included based

on specific responses to the PERQ. Appendix I shows a template of the A5 pages within the database. Below provides a summary of each A5 page.

Front Cover

The front cover of the booklet served as a covering letter explaining the contents and providing the contact information of the researcher. If the household was a responder, the covering letter thanked them for their response and explained that the booklet had been designed to be relevant to them. For non-responders/not initially selected households the covering letter was addressed to the occupant and explained that the booklet sort to make them aware of local and national organisations that may be of interest to them. To further personalise the booklet, the page displayed a '<TOWN> with Plymouth University' logo which was specific to the recipient's town. A total of 34 'with Plymouth University' logos were produced to be specific to each of the 39 interventions postcodes.

Using the internet for health

A page discussing the potential of using the internet for health, as well as advising the recipient about what is available and how to be safe online regarding their health. The page listed example websites which were accredited and suggested other uses, such as forums for advice and support. In addition, it reminded recipients to use trusted websites and that any information they post is in the public domain.

NHS Choices

An informative page providing details about NHS Choices [186]. NHS choices is the UK's biggest health website providing comprehensive health information in areas such as symptoms, medicine, lifestyle and NHS services across

England [187]. It includes more than 20,000 articles collating knowledge and expertise from NHS Evidence [188], the Health and Social Care Information Centre (HSCIC) [189] and the Care Quality Commission (CQC) [190]. NHS Choices is certified by the Information Standard [191] as a producer of reliable health and social care information. This page was designed to direct an internet user towards certified and reliable online health information. In addition it listed URL's to several features available through NHS choices such as; 'Browse Health A-Z' [192], 'Check your symptoms' [193], 'Find out more about medicine', 'Read common health questions' and 'Find a service near you'.

The information prescription service

The Information Prescription Service (IPS) [194] is a tool offered by NHS choices. It is designed to amalgamate information from across NHS choices and charity partners into one place, making it easier for users to find the information they need. It lets a user tailor the amount and type (including text, video, audio) of information they receive at any one time. The information prescriptions are designed to give people with long-term conditions, or care needs, information to help them manage their health more effectively and live more independently. They contain information, and signposts to further sources of advice and support, such as how to find local support groups [195]. The page explained information prescription and provided a simple guide on how to use the service.

Health information on Social Media

A page emphasising the potential of social media for health-related activities. The NHS has a wide presence across social media using it to engage patients and provide up to date information. The page highlighted and provided a brief description of the NHS choices' Facebook, Twitter and Youtube account. In addition, it reiterated that social media posts are public and recipients should be careful what they disclose.

Health apps for phones and tablets

A page highlighting the availability of health apps for both smart phones and tablets. The page directed recipients towards the NHS Choices health apps library [196], a database containing safe and trusted apps to help people manage their health. All apps are reviewed by the NHS to ensure they are clinically safe and relevant to people living in England. App categories in the

database include conditions, healthy living, health information and social care. The page provided two example apps, the British Heart Foundation recipe finder which provides recipes for people with high cholesterol, blood pressure and/or diabetes. And the Healthy Living app which is comprehensive guide on healthy living with information on health tips, help and advice.

Additional online health services

A page containing a list of additional reputable websites for health information, local services, forums, and patient feedback. The page included several condition specific webpages, such as Dementia UK and Stroke Association. The listed health information websites were all certified by the Information Standard [191].

GPs close to your location

A page designed to inform the reader of online services that can be available through a GP's website and information on the online services offered by their local GPs. The page included a description of online repeat prescriptions, online appointment booking and online access to medical records as well as highlighting the potential benefits of using these services. Local GP information was obtained by inputting the recipient's postcode into the NHS choices 'Find GP services' webpage [197] (a directory containing all English GPs). The two closest GP surgeries were then selected to be included. The NHS choices directory does include information on the online services that GPs provide however this is often poorly maintained and can be inaccurate. To overcome this, the selected GPs' information was entered into Google search engine to identify practice websites. Practice websites were then examined to identify the available online services and to obtain correct contact details.

A total of 36 variations of this page were produced to be specific to each of the 39 intervention postcodes (six postcodes shared the same closest two GPs).

Like to help someone to use the internet?

A page designed to provide recipients with information on how they could volunteer to help others use the internet. Digitalskills [198] is a website created by Go ON UK designed to be a central hub for all people, projects or organisations assisting others by teaching digital skills. A user can join the website and add themselves, or a project they know of, to an interactive map.

Christine's Story – Staying connected to my Grandson

A page containing a case study taken from the UKOC website [199] which details why and how an elderly non-user, Christine, learnt to skype. Christine explains how she was fearful of technology and had no intention to learn until her Grandson moved to America. When her family showed her the potential of skype to stay in touch she became motivated to learn and visited a local UK online centre. Christine's story is designed to show a non-user the benefits of using the internet and to provide an example of how they could 'go about' learning to use the internet.

How have others benefitted?

A page designed to show non-users the potential benefit of going online. The page used results from the Plymouth SeniorNet study, a project which aimed to recruit volunteers aged 50+ to help older non-users age 65+ online [200]. Specifically, the page displayed participants' response to a question asking them to rank how they had benefitted from using the internet. The highest ranked benefit was better communication with family and friends via skype or email or the ability to share and receive photos. The page was intended to

highlight benefits which may not have been obvious to a non-user but were likely to be more relevant and appealing to them.

Free training and assistance to use the internet

A page taken from the UK online centres (UKOC) marketing toolkit A5 leaflet [184]. The leaflet is designed to be handed out at UKOC facilities. It encourages an individual to 'Do more online' by listing the benefits of using the internet including saving time and money. In addition, a section titled 'Find the help and support you need' informs the reader that UKOC offers training and support for people of all computing abilities and provides an individual with the confidence to go online for whatever they need.

Places that offer help to use the internet

A page designed to inform the reader of their closest local UKOC partner centre and their closest specialist home access centre. According to UKOC, at a partner centre an individual can find friendly help and support to improve their skills, as well as access to the internet. A specialist home access centre offers support and advice to help an individual get online access in their own home and may have a range of internet enabled devices which a person can try out. The closest partner and specialist centre for each postcode was obtained by inputting the intervention postcodes into the UKOC 'Find a Centre' search, located on the UKOC website [99].

Online learning to improve internet skills

A page with information on the 'Learn My Way' online learning platform [185]. Learn My Way is a website which offers free online courses for beginners, helping a person develop their own digital skills. Courses range from basic skills such as using a mouse, keyboard and email to more specific tasks

including online banking, shopping online and staying healthy online. Clearly a person who is unable to use a mouse would be unable to navigate to the website alone, therefore the basic courses are designed to help a person who has some sort of support available to them. Whether this is a relative or friend with an internet connected computer, or potentially a local library/ public facility which can help an individual to navigate to the page and begin the courses. On the other hand, a person who already possesses basic computer skills, but may lack the knowledge or confidence to progress further, can visit the website and work their way through the courses in their own time.

The page included a quote from 'Karen' who had completed the online plus course; she explains how she had basic online skills but the course taught her how to shop and bank online. She is not afraid of the computer anymore and now she has started learning she doesn't think she will ever stop. The quote was included to provide a relatable example to individuals who may struggle to use the internet.

Help using the internet with a disability

A page with information about AbilityNet, an organisation which exists to change the lives of disabled people by helping them to use digital technology at work, at home or in education [201]. Some people may need specialist equipment to access the internet effectively and potentially need help choosing the correct equipment suited to their needs. Others may want to know about settings already available on their computer such as windows accessibility options. AbilityNet offers free services to people with a disability aiming to help them get the most from computers and the internet. The page listed the web address of AbilityNet and a free helpline number which provides advice for disabled people and the families, friends and carers who support them.

5.3.2 Trigger questions in the PERQ

The PERQ was analysed to identify key questions which could allude to the specific needs of the responder. These questions are referred to as 'Trigger Questions', how an individual responded to these questions triggered the inclusion/omission of different information. This was designed to ensure that the information received was as relevant as possible to the individual. This process followed a decision tree (see below)

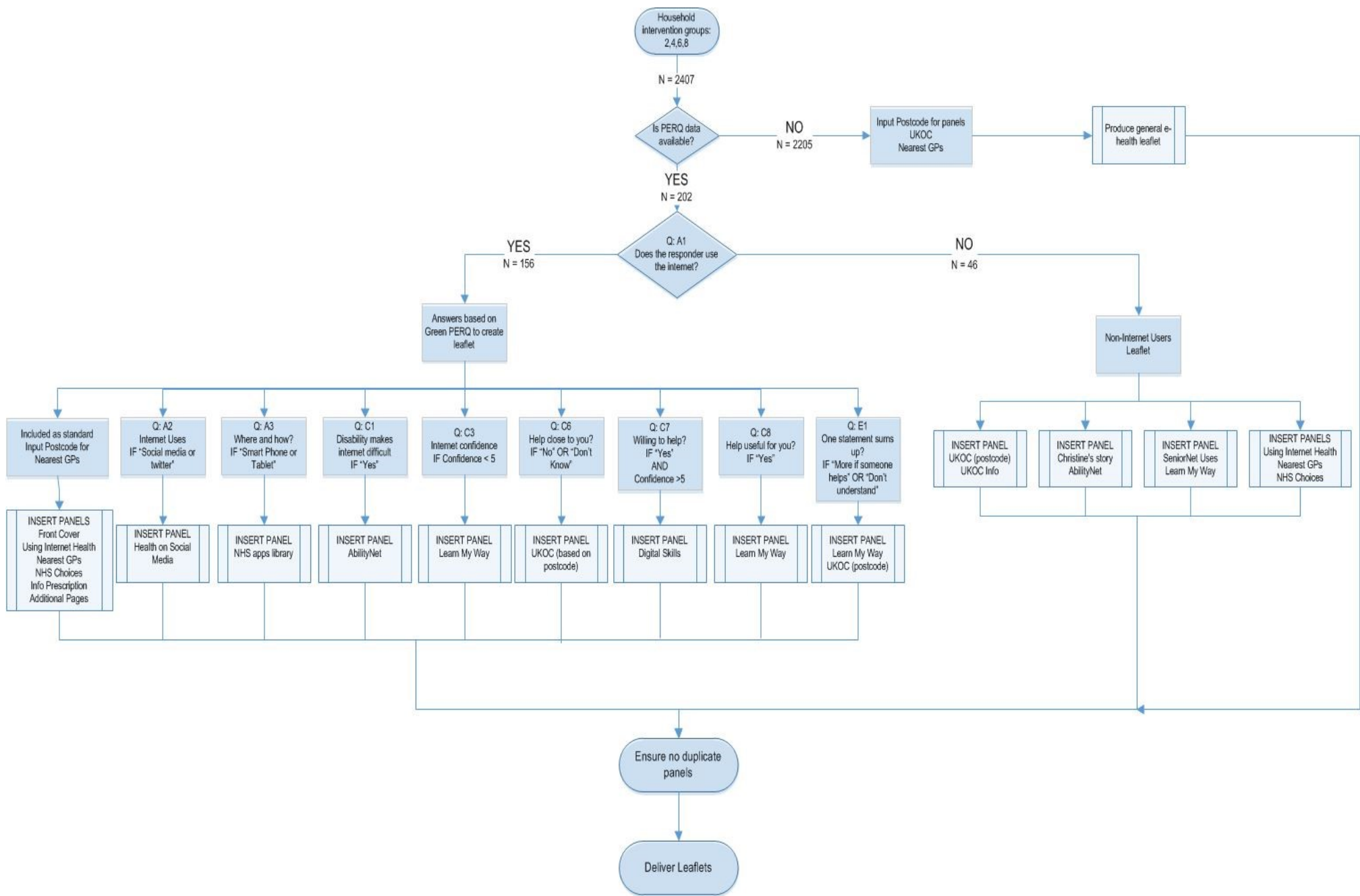


Figure 11. Flow Chart of Booklet Creation

A1- User Vs Non-User

The returned questionnaire indicated whether an individual had used the internet in the past three months. This immediately split responders into internet users and non-internet users. A non-internet user is not likely to benefit from being recommended purely internet based health resources, on the other hand an internet user would not benefit from being show places they can learn pc skills. Non-users received a standard non-user booklet (see 4.1.4). Internet users' responses were further analysed to tailor the contents of their booklet.

A2 – Uses of the internet (social media or Twitter)

This question identified what the responder uses the internet for. The response of using social media or Twitter acted as a flag to include information on the NHS presence on social media. A person who uses social media could potentially use the resource for health-related activities. Recently the NHS social media presence has increased [202]; people may not associate this with social networking.

A3 – Where and how do you access the internet? (smart phone or tablet)

Responders indicated how and where they used the internet in the past 3 months. With the increased popularity of smart phone and tablets it has now become a popular way to access the internet. Moreover, it makes the use of apps possible, which can be used for health-related activities. Smart phone users may gain from knowledge of apps which can be beneficial to their health. If the responder stated that they had used a smart phone or tablet to use the internet the A5 page “Health apps for phones and tablets” was included in the booklet.

C1 – Disability makes using internet difficult

Having a disability can make using the internet difficult and can potentially limit the ability to access certain information or support. This can act as a significant barrier to a person's use of a computer and internet. Identifying this and providing support for the individual can potentially increase their accessibility to the internet. Responders indicating that they had a disability which affected their computer use received information on AbilityNet.

C3 – Internet confidence (<5)

An individual may be able to use the internet for certain tasks, perhaps taught or basic, but they may have a lack of confidence in their ability to use the internet for health-related tasks. This could potentially prevent them from learning new tasks or exploring additional internet resources. A person who can use the internet but has low confidence scores may benefit from online training to enhance their personal ability and confidence. Responders reporting a confidence score of less than 5 for health-related tasks triggered 'Online learning to improve internet skills' page, with information on LearnMyWay.

C6 – Help close to you

This question asked if an individual knew of any local support centre or phone/email service which could help them or another individual to use the internet. A person who is completely confident using the internet is unlikely to benefit from such services; however, this individual may have family members, friends or neighbours which could potentially benefit. By making an individual aware of such services could potentially 'trickle down' to individuals who could benefit but may be unaware of the services. Individuals who responded 'Don't Know' or 'not that I'm aware of' received the 'Help close to you page'.

C7 – Willing to help or volunteer

A person may be a proficient internet user and could potentially volunteer to help other individuals to use the internet. They may be unaware of how or where they could help. Although a person may be willing to help they may not be skilled enough to do so effectively. Responders who answered that they were willing to offer support and had a confidence score >5 received the 'Volunteer to help others page'.

C8 – Help useful for you

A question asking if the responder has ever felt that help using the internet for health would be useful for them. Individuals responding 'Yes' received the 'Online learning to improve internet skills page'.

E1 – Which statement sums up your attitude

Responder were asked which one statement, from a total of seven, best sums up how they feel about using the internet for health. Individuals who indicated that they would use the internet more if they could get someone to help or that they don't understand the internet that much received both the 'Places that offer help to use the internet' and 'Online learning to improve internet skills page'.

5.3.3 Internet user booklet

Internet users' booklets included several pages as standard in addition to the process above. These included the Front Page, Using the Internet for Health, NHS Choices, Information Prescription, Additional Online Health Services, GPs Close to You and the Back Cover. These pages formed the basis of the booklet with additional pages then being included as required.

Due to the method of printing the total page length had to be divisible by four (A4 double sided). This meant that in cases where the tailoring process produced booklets of unsuitable size, certain pages were added for logistical reasons. In cases where the length was exceeded by one the 'Back Cover' page of the booklet was removed and replaced with an informative page. Alternatively, a contents page or additional informative pages were added to achieve the required length. Pages which had been included based on the tailoring process were not removed at any point.

A total of 156 tailored internet user booklets were produced with length ranging from 8-16 pages.

5.3.4 Non-internet User booklet

Non-internet users received a non-user booklet which was personalised using their name and tailored based on their postcode. It was initially planned that non-user booklets would be highly tailored based on responses to the PERQ. However, upon further inspection of the information available from the non-user version of the PERQ it was decided that precise tailoring could potentially omit useful information for the responder. For example, an individual has no interest in using the internet the internet may benefit from seeing how the internet has benefitted others. If this was successful in encouraging them to learn internet skills, they would also require information on how to achieve this. An individual who is relatively keen to learn internet skills would require information on how to achieve this. Similarly, they would also benefit from seeing how others have benefitted to further increase the desirability of learning.

The non-user booklet contained a personalised front cover, a contents page and a selection of informative pages (see below). A total of 46 non-user booklets were produced.

Leaflet Contents	
PAGE	TITLE
3	Christine's Story - Staying connected to my Grandson
4	How have others benefited from the internet?
5	Free training and assistance to use the Internet
6	Places close to you that offer help to use the Internet
7	Online learning to improve internet skills
8	Help using the Internet with a disability
9	Using the Internet for Health
10	NHS Choices
11	GPs close to your location

2

Figure 12. Non-user contents page

5.4 Standardised booklets

The booklet intervention groups included a total of 2205 non-responders/households not randomly selected to complete the baseline PERQ. As no specific data was available for these households tailoring was limited to geographical data only. A standardised booklet was produced for each of the

39 postcodes, differing only in town logo, closest GPs and closest UKOC location. Booklets were assembled using the same A5 pages used to construct the tailored booklets.

It was not possible to distinguish if the household was an internet user or non-internet user, for this reason the standardised booklet included information relevant to both groups. To make this clearer to the individual a contents page was added which colour coded each section. Standardised booklets contained a total of 16 A5 pages (see Figure 13) including a front cover which was addressed to the household.

Leaflet Contents	
The enclosed information has been designed to provide helpful information to both internet and non-internet users.	
To make this clearer the table of contents has been divided into information for: internet users , non-internet users and for everyone .	
PAGE	TITLE
3	Using the Internet for Health
4	NHS Choices
5	The information prescription service
6	Health information on Social Media
7	Health apps for your phone or tablet
8	Additional online health services
9	Christine's Story - Staying connected to my Grandson
10	How have others benefited from the internet?
11	Free training and assistance to use the Internet
12	Places close to you that offer help to use the Internet
13	Online learning to improve internet skills
14	Help using the Internet with a disability
15	GPs close to your location

2

5.5 GP Intervention

5.5.1 Overview

An intervention was conducted at the GP level. This intervention involved: (i) the researcher contacting the selected practices to arrange a meeting. This written contact explained the project and attempted to seek permission to attend a practice meeting to discuss use of eHealth services by the practice. If this was not possible, the researcher tried to meet with a member of the practice or establish an e-mail conversation. (ii) GPs were given suggestions as to how they might expand from their current use of eHealth services to use additional eHealth, using examples of GPs in their area or nationally. (iii) GPs were also asked to comment on the services they offer, perceived benefit/detriment and ease of adoption.

A data log was kept describing the process of the GP intervention including responders/non-responders and the reaction to the intervention. GPs websites were assessed before and after the intervention.

5.5.2 Intervention Process

A Google search was conducted to ascertain the practice website URL for the 78 practices serving the postcodes within the sampling frame. When a practice website had been identified, the researcher examined the availability of online appointment booking, online repeat prescription and online access to medical records. This was designed to record the current level of eHealth service provision offered throughout Cornwall at practice level.

The identified practice websites were used to obtain the up-to-date contact details, including practice manager name, for the 39 practices included in the GP intervention. The researcher was unable to locate the practice website for one of the intervention GPs, on further investigation it was apparent that this GP was a specialised centre designed to treat homeless residents in the area, therefore it was not suitable to be included in the study.

5.5.3 Meeting format and content

Where possible the researcher attempted to attend a practice meeting. This served two purposes, firstly it was hoped that this would have the most penetration within the practice. Within a meeting environment the potential benefits are displayed to all members of staff, as opposed to meeting one on one with a practice manager who may then struggle to pass on or persuade GPs to adopt discussed services. Secondly, it was designed to encourage discussion within the practice. Having all staff in one meeting discussing the topic of eHealth brings the topic into focus. It is likely staff within the same practice have differing opinions towards eHealth, encouraging discussion may lead to other GPs detailing the benefits they have gained using aspects of eHealth. Essentially this would serve as an internal intervention, with more eHealth positive GPs discussing the topic with their colleagues.

A total of six topics were covered within the meetings that ran for approximately 15 minutes the detail of the topics and their justification for inclusion is discussed below. Meetings were tailored to consider the current services provided by the GP practice, if discussed services were currently implemented the conversation would focus on the difficulty the GP experienced to implement and any perceived benefits/limitations of the system. The researcher took

examples of the tailored booklets along to the meeting to show GPs other eHealth interventions in their area.

The GP intervention was designed as an evolving/iterative process; it was planned that responses from the initial meetings could then serve as examples for later meetings. To elaborate, an early intervention meeting could take place at a GP practice which uses information prescription as a standard process, they may report that the service was easy to adopt and has been hugely beneficial to the surgery and patients. At a later intervention, a practice may not offer this service, in this scenario the researcher would include the example of the first practice's response regarding this service. It was hoped that this would make the example more relatable to the GP due to its locality and similarity. In this instance, having the knowledge that a surgery within the area easily adopted and benefitted from information prescription, should increase the likelihood of implementation.

5.5.3.1 Online appointment booking & repeat prescription

The process of allowing patients to book appointments and order repeat prescriptions using an online service was discussed with GPs. NHS England's pledge to offer additional online services included help and support documents along with details on the potential benefits to practices [203]. Benefits included fewer transcription errors, improved audit trail, fewer phone calls and face-to-face transactions with patients, easier for patients to cancel or re-book appointments and increased convenience for patients. GPs who already offered this service were asked to detail their experiences with implementing the service so this could be used as 'relatable' examples for practices within the area.

5.5.3.2 Online access to medical records

Online access to medical records allows patients to view information including test results, GP consultation notes and any correspondence between hospital consultants and GPs via the internet. The feasibility of providing online access to medical records was discussed using the example of Haughton Thornley Medical Centre [204]. Haughton Thornley was one of the first surgeries to offer online access to medical records. The service, championed by Dr Amir Hannan, was implemented to increase patient visibility and trust following the conviction of Dr Harold Shipman.

Post implementation the practice has reported several benefits, their patients have a more active role in their own healthcare and have developed a more trusting relationship with their GP. The practice reports that this increased access is estimated to have reduced overall appointment rates by 11% a year. Haughton Thornley has become a pioneer of the service, they have published a web page [205] which discusses the benefits but also details how the service was adopted. In addition, Dr Hannah has created a series of Youtube videos [206] and a list of ten reasons why the service should be used.

5.5.3.3 Information prescription

Information prescriptions can be defined as “prescriptions of specific, evidence-based information to manage health problems.” [207] like the prescription of a medication or a treatment plan, healthcare professionals can prescribe information to help educate patients. GPs were asked if the process of information prescription was implemented within their surgery. The NHS IPS [208] was presented to attendees, this NHS service allows for the creation of a document containing information about a condition in a variety of content

including text, audio and video. The service also includes information on local services (based on postcode) which can be helpful to a patient with a condition.

The researcher discussed how such a service could be implemented within the practice, suggesting that GPs can act as 'gate-keepers' actively prescribing and directing patients to recommended health websites or potentially print off this information for non-internet using patients.

5.5.3.4 Phone triage

Phone triage allows practices to assess patient's symptoms and concerns, and then agree with the patient how these needs may best be fulfilled by giving telephone advice or a face to face appointment. Phone triage does not require an internet connection or use of the internet to be implemented and is arguably not an eHealth service. It was included in the intervention meeting from a process point of view. The potential future use of video consultations would require a similar process to that of phone triage. Patients would have to select a timeslot in which they could contact their GP from a distance, and advice would be given without a physical examination. Essentially the use of phone triage is an earlier technology to deliver similar outcomes to that of video consultations. A GP using a phone triage system should feasibly be able to implement future video consultations easier, many of the concerns regarding phone triage are likely to translate to concerns with video consultations.

The example of St Levan Surgery [209], located in Plymouth, was used to highlight a local practices experiences and opinions using the service. St Levan often had an overcrowded waiting room and opted to adopt phone triage system in 2008. Since adoption, St Levan have reported that all patients are now able to speak to a doctor on the day that they ring. In addition, 50% of patients are managed without the need for a face-to-face appointment, have shorter waiting

times, less need to wait with other ill patients, doctors and staff are less stressed and there is greater flexibility in appointment length to deal with complex problems.

5.5.3.5 Video consultations

The potential use of video consultations was presented to GPs as the final topic of the meeting. This topic was discussed in relation to the Superfast Cornwall project highlighting how the increased speeds may make it feasible to offer live video consultations to patients. The benefits from its use in areas such as dermatology were detailed, along with highlighting its potential to reduce travel for patients, which could be particularly beneficial in the rural county of Cornwall.

5.5.4 Researcher's diary and measure

During the meeting the researcher kept a diary, which noted comments and opinions offered by GPs and practice staff. Following the discussion of each topic, attendees were asked to complete a simple measure (Appendix J) to provide their response on perceived usefulness and difficulty to implement. Where only e-mail contact could be established the researcher e-mailed this measure to the practice along with a written version of the discussed topics.

CHAPTER 6. RESULTS

6.1 Intervention process

6.1.1 Household intervention

A total of 2361 eligible households (baseline refusals excluded) were present in the clusters allocated to receive a household booklet intervention. One-hundred and fifty-six of these households had completed the baseline survey and received a tailored booklet (Chapter 5) in the post. The remaining 2205 received a standardised booklet for their postcode.

A total of five booklets were returned to the researcher, all were from the 2205 households that did not complete the baseline survey. Where booklets were returned, this was classed as a 'wish to withdraw' from any further contact regarding this project. These five households were classed as refusals and were withdrawn from the sampling frame.

The researcher received two e-mails from participants regarding the booklet, both were from tailored households and were simple 'thank you' e-mails saying they found the information useful/interesting.

6.1.2 GP intervention

A total of 38 GPs were contacted using the process outlined in Chapter 5, with 29 of these receiving reminder letters following non-response. Eight GPs responded and agreed to take part in the study (21.0%, 2 after reminder), three refused to take part due to busy schedules (7.9%) and a further 27 did not respond (71.1%).

The researcher could attend five face-to-face meetings and had email correspondence with the remaining three GPs. All responding GPs had their

own website and offered online repeat prescriptions. All but one of the GPs offered online appointment booking services via their website. None offered online access to medical records, but this was the case for Cornwall with no GPs offering this service during the intervention phase of the study.

Feedback from researcher's diary and GP measure

Most GPs offering online appointment bookings perceived the service to have been beneficial to their surgery, with only one reporting it had been detrimental to staff but beneficial to patients. The one surgery that did not offer the service felt it would be beneficial to patients and 'already had plans to implement the service within the next few months. However, by January 2016 this service was still not available through their practice website. All the GPs has positive or 'indifferent' attitudes to online repeat prescriptions and online appointment booking, with none reporting that it had been detrimental to their practice. All GPs had negative opinions towards phone triage, responses towards patient access to medical records were 'mixed' with no clear pattern between practices.

6.1.3 Superfast broadband intervention

The Superfast Cornwall project came to an end in March 2015. BT's initial target was to deliver fibre based broadband to at least 80% of homes and businesses in Cornwall. Superfast Cornwall reported that this target was exceeded with a network that covers 95% of premises, a total of 241,000, with nearly 90% able to connect at speeds of over 24Mbps [11]. As the roll-out progressed, take-up steadily increased and reached 66,537 connected premises in June 2015, meaning an estimated 28% of premises were using the fibre service as of June 2015.

With the Superfast Cornwall project completed more accurate rollout data was released to the researcher, this data contained precise 'go live' dates for all clusters (postcodes) included in the study. Analysing this data indicated that some initial timing estimates provided during the sampling method were inaccurate, therefore using the initial categorisation would have led to inaccurate comparisons. Some areas initially categorised as not having superfast broadband during the sampling method, received the intervention at that time point. To counter this, and to allow for more accurate analysis between superfast conditions, a new categorical variable (Superfast_Adjusted) was created to distinguish between clusters, and their contained households. The adjusted variable categorised areas with superfast broadband for 24+ months at follow-up as 'early receivers', and areas that have had superfast for 23 or less months as 'late receivers'.

6.2 Follow-up survey

The follow-up survey was delivered directly to households using the Royal Mail postage service. Households who had completed and returned the baseline survey received an envelope addressed to the previous responder. If the responder had previously opted not to provide a name, the covering letter listed the sex and age range of the individual with a request that the follow-up survey would be completed by that same person. Households who did not respond to the baseline survey received an envelope addressed to 'The Occupant' with the instructions that the survey should be completed by a person aged 16+ whose birthday was next in the household.

Households who refused the initial baseline survey were not included in the follow-up survey. These households were re-sampled to replace them with

another randomly selected household within the same cluster (postcode). This was used as an attempt to keep before and after sample sizes similar. A total of 45 households were re-sampled

The follow-up survey was delivered to 1383 households across 78 postcodes in the month of March 2015. A month following, non-responders (n=1123, 81.2%) received a reminder letter in the post.

6.2.1 Approach to analysis

The following sections detail the analysis of the study. As discussed the main dependant variable under investigation was eHealth Readiness in the form of a continuous variable, calculated from PERQ responses. Parametric tests were used to analyse eHealth Readiness and the sub-variables which contributed to its calculation (Personal, Provision, Economic, Support). On matched data, paired t-tests were used to compare baseline with follow-up. To examine differences between groups, independent t-tests were conducted on the change of continuous variables. These are reported within the text of the following sections.

The PERQ contained many categorical response questions which were relevant to the study. For categorical data, non-parametric tests in the form of chi-square tests for independent samples and McNemar, for paired data, were conducted. To provide further insight, in some cases additional categorical data was created from continuous variables to analyse proportions, for example increased, decreased, no change. These are again detailed within the appropriate subsequent sections.

6.2.2 Response rate

A total of 383 households responded to the follow-up survey (27.7%). Of these households, 259 had previously responded to the baseline survey (65.6% of original responders). One cluster provided no responses to either the baseline or follow-up survey meaning data was only available for 77 of the 78 sampled clusters. Figure 14 shows a summary and flow of household response data.

	PERQ Completed	
	Baseline	Follow-up
Number Surveyed	1388	1383
Total Responses	394 (28.4%)	383 (27.7%)
Completed Baseline Only (unmatched)	135 (9.7%)	
Completed Follow-up Only (unmatched)		124 (9.0%)
Completed Baseline and Follow-up (matched)	259 (18.7%)	259 (18.7%)

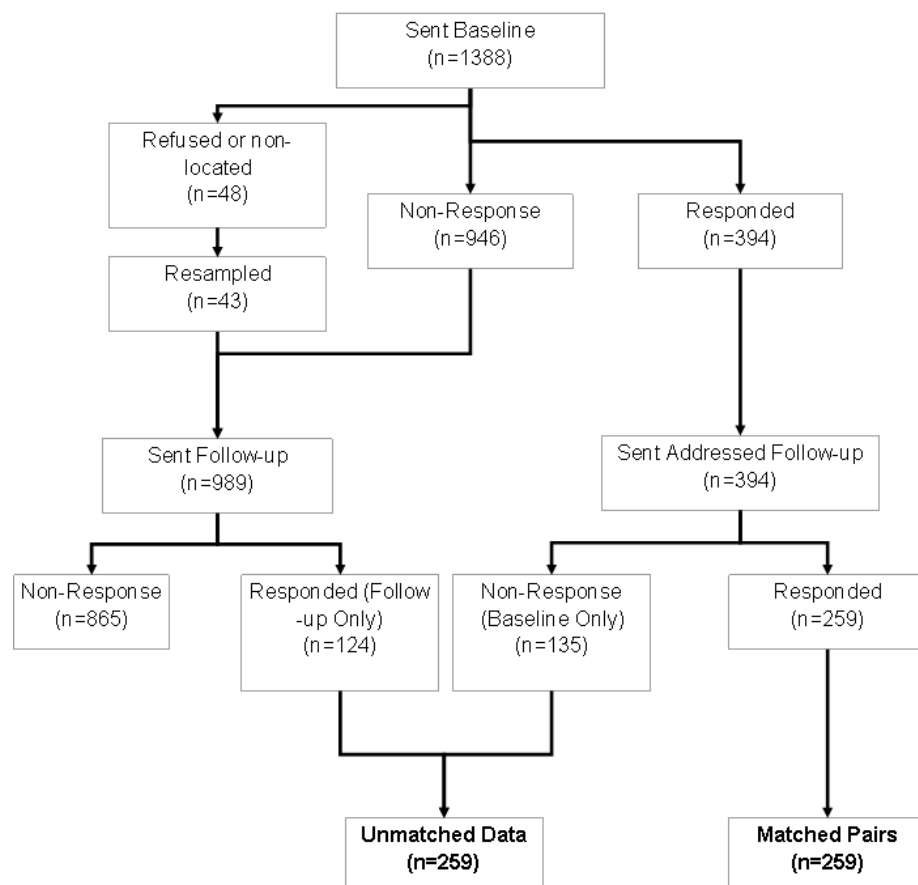


Figure 14. Household response data

6.2.3 Demographics of unmatched pairs

Demographic analysis was conducted on unmatched pairs (Baseline only vs Follow-up only) to identify if significant differences were present which could have acted as a confounding variable.

There was no significant difference in the proportion of male and females between baseline and follow-up (28.7% Male, 71.3% Female VS 37.8% Male, 62.2% Female, $X^2=1.938$, $df=1$, $p=.164$). The 'spread' of age was also consistent between baseline and follow-up with no significant differences in proportions within age categories ($X^2=5.54$, $df=6$, $p=.476$).

6.2.4 Overview of change within Cornwall

Change in Internet Use

Overall, using all measurements, the proportion of internet users increased significantly from baseline to follow-up (77% vs 82%, McNemar = $p<.001$).

On paired data, eleven non-users at baseline (11/54, 20.4%) reported using the internet in the previous three months at follow-up. As expected, an independent t-tests indicated that new-users had significantly higher increases in their Readiness scores compared to continued users (+1.56 vs +0.26, $t(197)=-4.76$ $p<.001$). One new-user of note, showed no increase in their Readiness score, on further investigation it was apparent that their Economic score had reduced greatly which countered any increases in their score. This indicated that with adoption of the internet, the added cost had become a large concern to them.

Five internet users at baseline (5/205, 2.4%) reported not to have used the internet in the previous three months at follow-up. Previous users who had stopped using the internet (new non-users) showed the most significant

decreases in their Readiness score, with an average reduction of 1.75.

Moreover, when compared to continued users, these five households had significantly lower Readiness scores at baseline (3.00 vs 5.04, $t(197)=3.78$, $p<.001$) than the 195 who were 'continued users'.

A higher proportion of households at follow-up had used their smart phones or mobile devices to access the internet compared to baseline (64.8% (129/199) vs 50.5% (101/199); McNemar =19.6; $p<.001$). Thirty-four previously non-mobile internet users reported use at follow-up with only six households reporting that they had stopped.

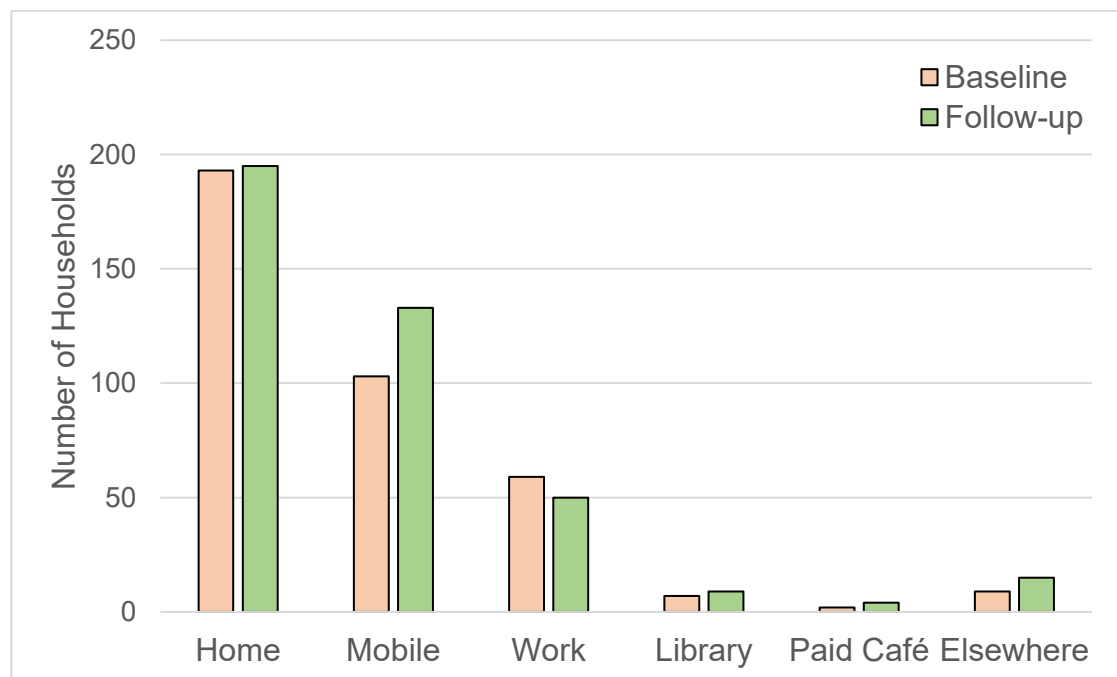


Figure 15. Where and how 211/259 matched households had accessed the internet in the last 3 months at baseline and follow-up

The pattern of use of the internet for health-related tasks remained similar to baseline. With 65% of internet users reporting having used Google to search for health topics, followed by 17% reporting using e-mail for health and 9% discussing health topics on a forum.

Self-reported 'barriers' to eHealth use remained similar to baseline, with most follow-up households (139/237, 58.6%) reporting that they 'have or would use the Internet for health and have no real barriers to that use'. A chi-square test indicated no significant change vs baseline (128/237, 54.0%, $p=.185$). The most common reported barrier at follow-up was 'No need for health information' (27/246, 11.0%) and 'I have no interest in using the internet' (27/246, 11.0%). Only three households (of 246, 1.2%) reported that they 'Would use the internet more for health if I could get a good internet connection', which was the least selected barrier.

A positive correlation was present between household Readiness scores and the number of months superfast had been available to the household ($r=0.103$, $n=731$, $p=.005$).

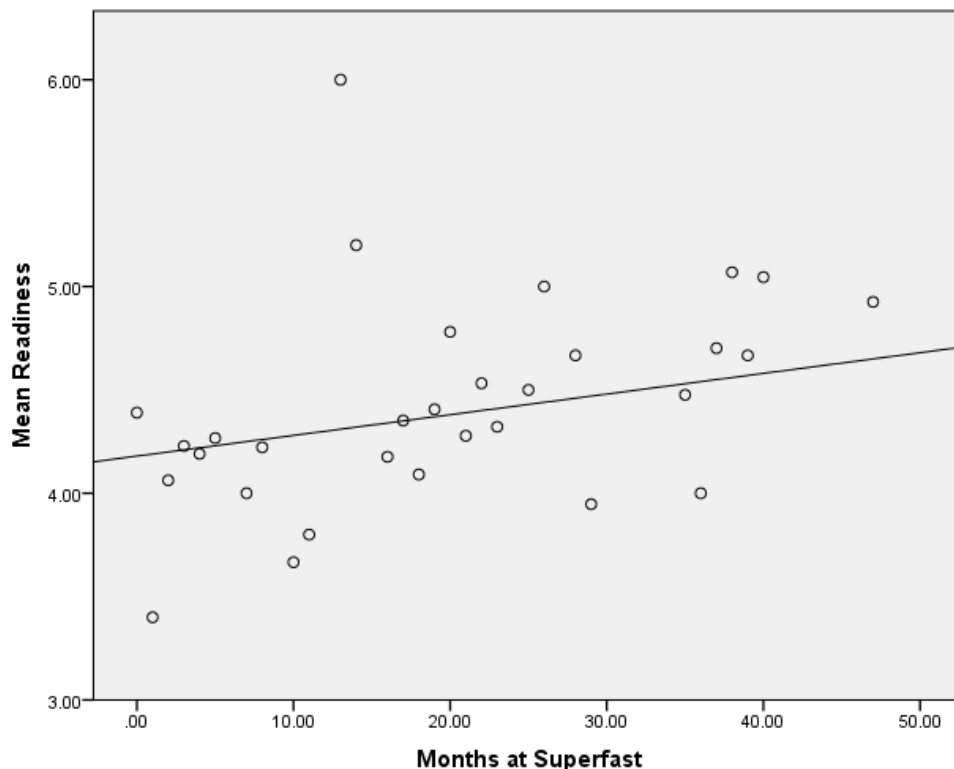


Figure 16. Correlation between households' Readiness score and months superfast available in area

Changes at Cluster Level

Responses of all households within clusters were aggregated to provide an average for each cluster. Simple paired comparisons for clusters, before and after, provided an initial outline of change in the area during the study.

Readiness scores were available for 73 of the 77 clusters. Most clusters (48/73, 66%) increased in Readiness scores, with a maximum increase of 2.75. Eight clusters (of 73, 11.00%) showed no change, with the remaining 17 (of 73, 23.3%) decreasing in Readiness score (maximum decrease 2.33). Figure 17 shows provides a visual representation of changes per cluster.

This process was repeated using only matched household data (n=259), resulting in Readiness scores for 70 clusters. As above, most clusters increased in Readiness score (38/70, 54.3%), with a maximum increase of 2.0. Twenty-two clusters (22/70, 31.4%) showed no change with just ten (10/70, 14.3%) decreasing in readiness (maximum decrease -1.0). Figure 18 shows a visual representation or changes in clusters using matched household data only.

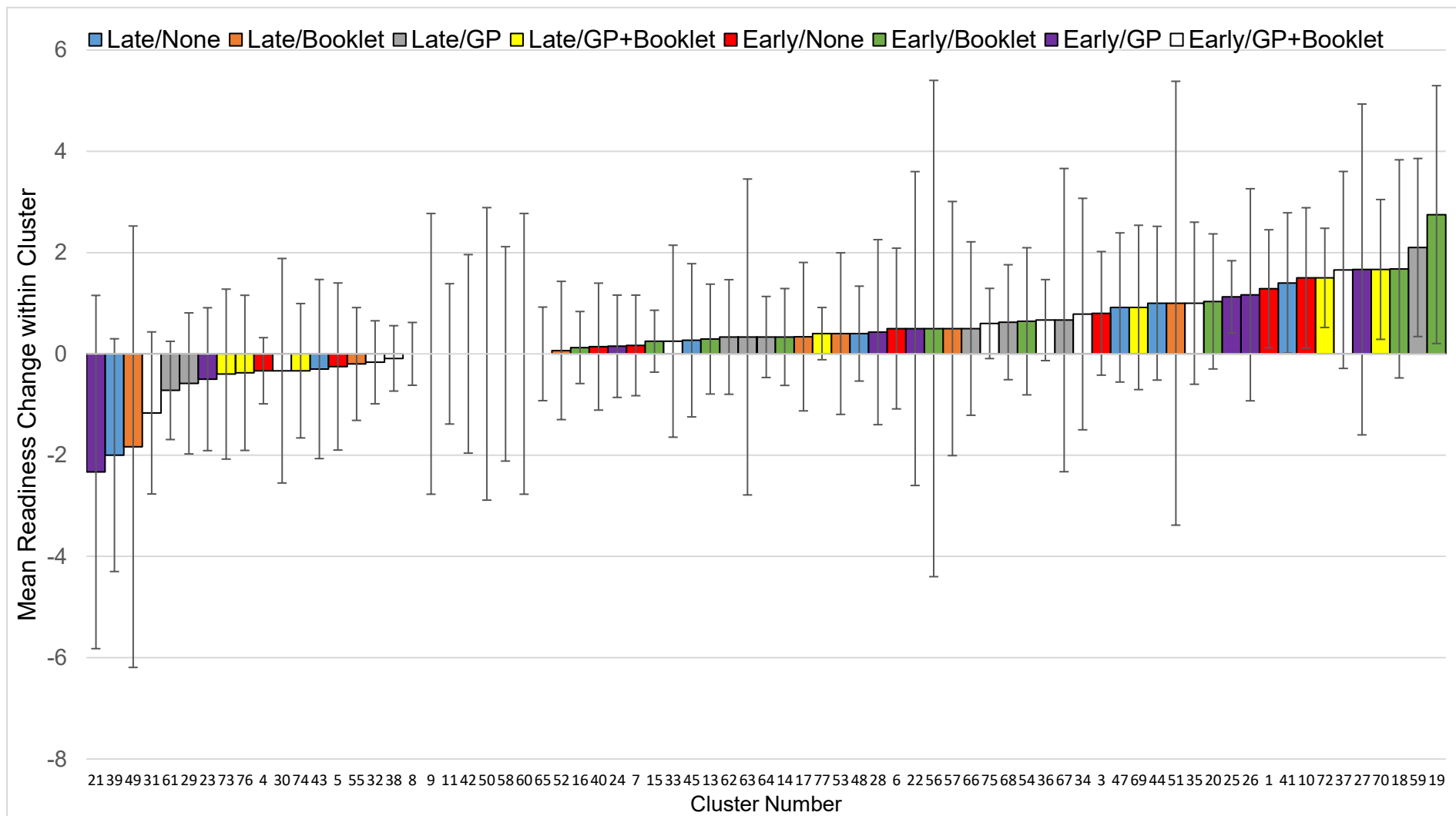


Figure 17. Mean change in Readiness score per cluster (all data)

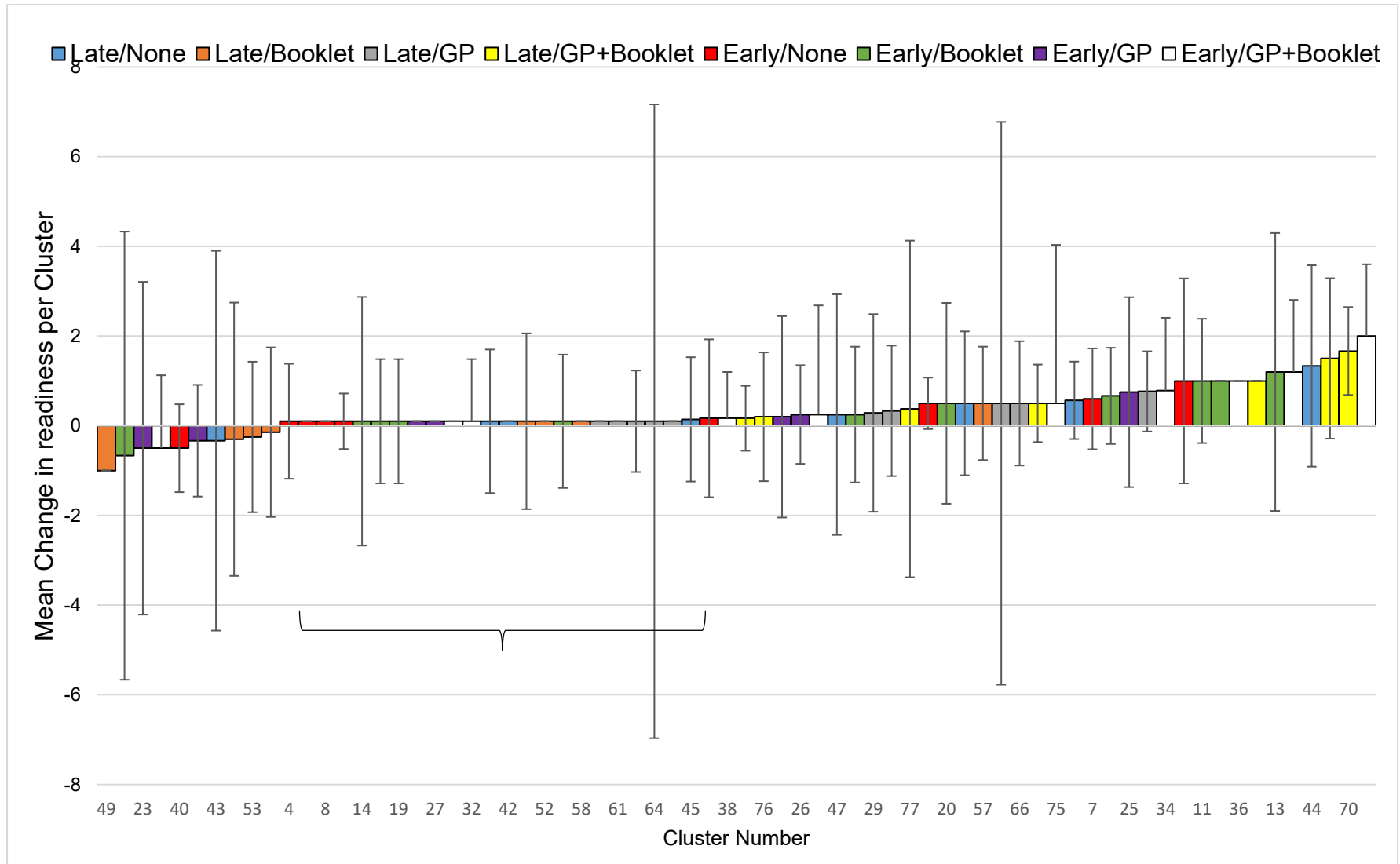


Figure 18. Mean change in Readiness score per cluster (matched households only)

6.2.5 Readiness change within households

A total of 259 households completed both the before and after survey.

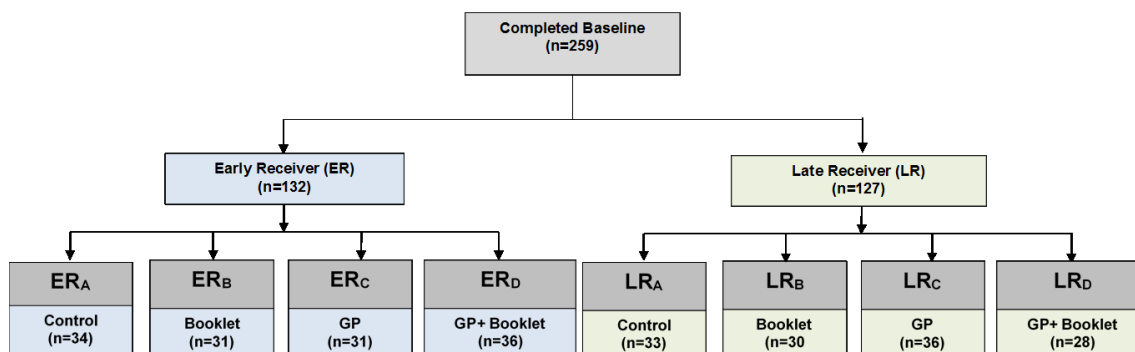


Figure 19. CONSORT diagram of trial numbers for matched households

Twenty-three households (8.9%) had missing data at either baseline or follow-up which prevented the calculation of a Readiness score. This left 236 households with 'complete' data. Most households (121, 51.3%) showed no change in their eHealth Readiness score, a further 79 (33.5%) increased in Readiness score with a maximum increase of 3. The remaining 36 households (6.9%) decreased in Readiness score, with a maximum decrease of -3.

Table 1 Summary of key continuous variables on matched households

	Baseline		Follow-Up		Change	
	MEAN	SD	MEAN	SD	MEAN	SD
Readiness	4.36	1.72	4.59	1.78	+0.23	+0.06
Personal	5.49	2.92	5.77	2.94	+0.28	+0.02
Provision	4.06	1.70	4.26	1.78	+0.20	+0.08
Support	1.89	1.87	1.88	1.80	-0.01	-0.07
Economic	1.57	0.90	1.67	0.88	+0.10	-0.02

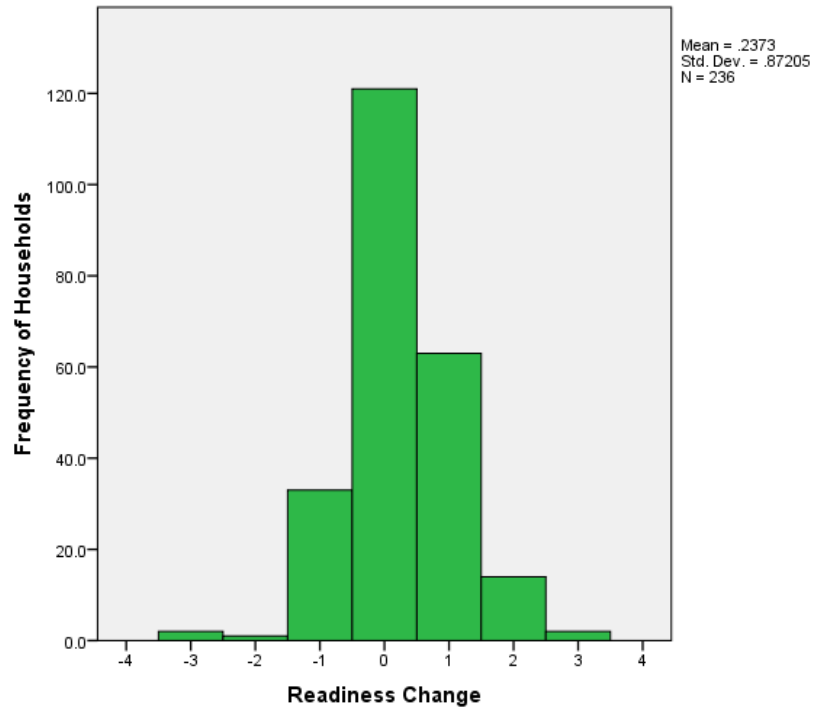


Figure 20. Histogram of readiness Change on Matched Pairs

Overall eHealth Readiness scores increased significantly from baseline to follow-up for these 236 households ($M=4.36$ vs $M=4.59$, $t(235)=4.18$ $p<.001$, $CI=0.13-0.35$). The standard deviation of readiness among responders remained similar (1.72 vs 1.78) which indicated that eHealth inequalities remained similar despite the increase of Readiness scores. Further analysis conducted on purely 'continued users' (used internet at both baseline and follow-up) again showed significant increases in Readiness scores ($M=5.04$ vs $M=5.30$, $t(189)=4.57$ $p<.001$, $CI=0.15-0.38$).

Analyses of the sub-variables which contribute to the calculation of eHealth Readiness scores indicated that both Personal and Provision increased significantly over the 18 months ($t(255)=3.191$ $p=.002$, $t(258)=3.410$ $p=.001$). Whereas Economic and Support sub-variables showed no significant change.

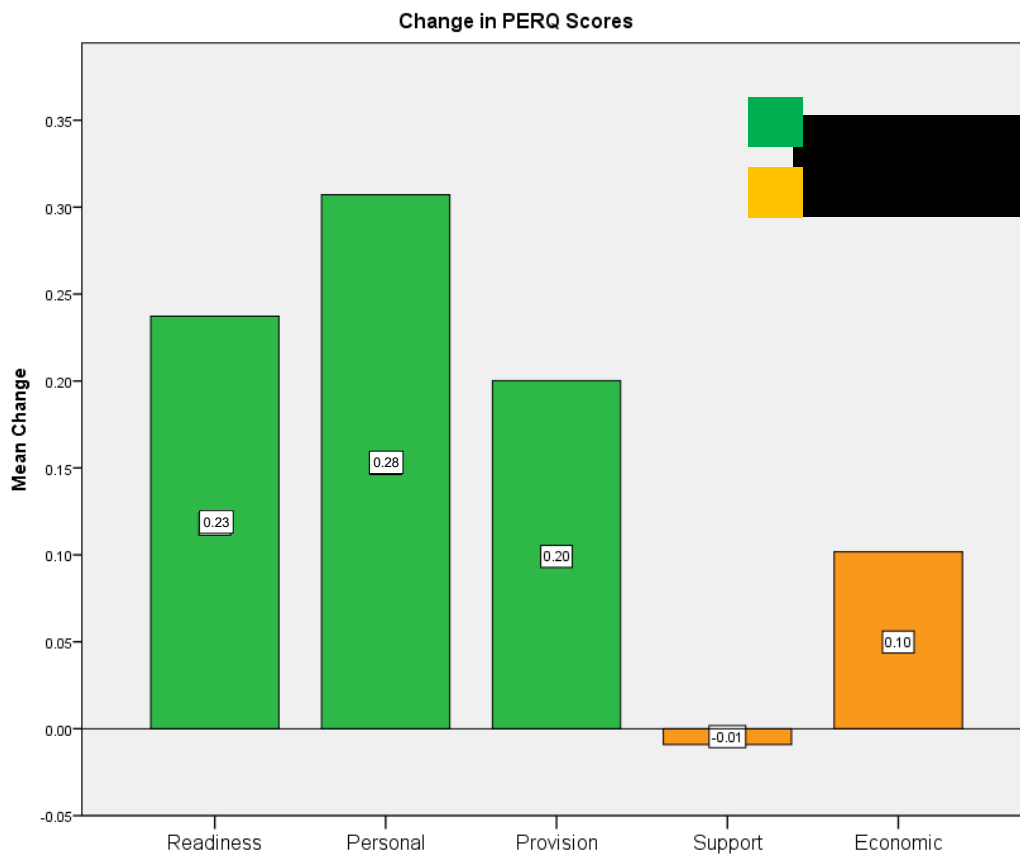


Figure 21. Change in PERQ variables

6.2.6 Booklet intervention

A total of 125 households (48.3%) who completed both baseline and follow-up had received the booklet intervention, either separately or in combination with the other interventions. As baseline information was available for all these households, each received a form of the tailored booklet based on the process discussed in Chapter 5.

One of the main aims of the booklet intervention was to direct individuals to sources which would enable them to improve their skill at using the internet and confidence in using eHealth services. The PERQ calculates a separate skill score based on responders reported self-ability to complete six internet related

tasks. Analysis of skill scores showed that households who received a booklet showed no significant increase in their skill score compared to non-receivers (+0.46 vs +0.95, $p>0.05$).

One area of the booklet focussed specifically on the eHealth services offered by local GPs' websites, to attempt to increase knowledge and use of these services. At baseline a total of 65 households reported that they 'Didn't Know' if their local GP had a website, of these, 34 had become aware of their local GPs website and the services it offered. However, this change did not differ between control and booklet households (18, 51.4% vs 16, 53.3%)

The proportion of households reporting that they had, 'found what they were looking for' when searching online for health information and 'were able to contact health organisations online', also did not differ between booklet conditions.

A chi-squared test indicated that the proportion of households increasing in Readiness scores was not significantly different between receiving and not receiving the booklet intervention ($X^2=1.165$, $p>0.05$).

Table 2. Proportion of readiness change between Booklet conditions

			Booklet Intervention		Total
			None	Booklet	
readiness	Increased	Count	37	42	79
		% within booklet	30.6%	36.5%	33.5%
	No Change	Count	66	55	121
		% within booklet	54.5%	47.8%	51.3%
	Decreased	Count	18	18	36
		% within booklet	14.9%	15.7%	15.3%
Total	Count	121	115	236	
	% within booklet	100.0%	100.0%	100.0%	

A t-test indicated that there was no significant effect of the booklet intervention on the change of Readiness scores ($t(234)=-0.106$, $p>0.05$).

The number of households within the booklet condition who acknowledged receiving 'a booklet in the post regarding using the Internet for health' was just five (5.2%).

6.2.7 GP intervention

There was no significant difference between trial arms (control vs GP) on the proportion of households who had been given information to help them use the internet for their health, by a nurse, doctor or another health care professional (19.2% vs 18.3%, $\chi^2=.028$, $df=1$, $p>0.05$).

A chi-squared test indicated that the proportion of households increasing in Readiness scores was not significantly different between those in the GP intervention arms and those in other arms of the trial (32.5% vs 34.5%, $\chi^2=0.616$, $p>0.05$, Table 3). A t-test indicated that there was no significant effect of the GP intervention on the change of Readiness scores ($t(234)=-1.010$, $p>0.05$).

Table 3. Proportion of readiness between GP Trial Arms

			GP Intervention		Total
			None	GP	
readiness Increase	Increased	Count	38	41	79
		% within GP	32.5%	34.5%	33.5%
	No Change	Count	59	62	121
		% within GP	50.4%	52.1%	51.3%
	Decreased	Count	20	16	36
		% within GP	17.1%	13.4%	15.3%
Total	Count	117	119	236	
	% within GP	100.0%	100.0%	100.0%	

As reported earlier in the chapter, the researcher was unable to contact many GPs within the GP intervention arm (30/38). Therefore, further ‘as treated’ analysis was conducted on households from GPs that had contact with the researcher. The increase of Readiness scores appeared different between visited (+0.46) and non-visited (+0.21) GPs, however this change was not significant ($t(234)=1.011$, $p>0.05$).

6.2.8 Superfast

Perception of internet speed

A total of 17 households (17/200, 8.5%) reported an improvement in the speed of their internet connection, from slow/none at baseline to fast enough at follow-up. Ten households (10/200, 5%) reported that their internet connection had worsened (slower/none) over the course of the study. The remaining (173/200, 86.5%) showed no change in the perception of their internet speed since baseline. There was no statistically significant difference in the perception of speed on matched pairs at baseline vs follow-up (McNemar=2.46, $p=.117$).

Changes in speed perception did significantly differ between superfast arms, with 12 households (of 81, 14.8%) from 'late receivers' and five (of 96, 5.2%) from 'early receivers' reporting faster internet ($X^2=4.67$, $df=1$, $p=.031$).

In unmatched households, a larger proportion of follow-up households reported having a fast enough internet connection (94/103, 91.2%) compared to baseline households (76/101, 75.2%), this difference was significant ($X^2=8.30$, $df=1$, $p=.004$).

Table 4. Households perception of speed Baseline vs Follow-up.

B1: Does your home?	Independent samples (Unmatched data)		Paired data (Matched data)	
	Before	After	Before	After
Fast enough connection	76	94	172	185
Slow or No Connection	25	9	33	25
	101	103	205	210

Change in readiness

There was no correlation between matched household's change in readiness and the number of months superfast had been available in the area ($r=-0.11$, $p=.863$).

A chi-squared test indicated that the proportion of households increasing in Readiness scores was not significantly different between adjusted superfast conditions ($X^2=2.88$, $df=2$, $p>0.05$, Table 5). There was also no significant difference between the change in readiness (0.26 vs 0.21, $t(234)=0.44$, $p>0.05$) or Provision scores (0.16 vs 0.23, $t(234)=-0.62$, $p>0.05$) between conditions.

Table 5. Proportion of households increasing in Readiness scores between Superfast arms

			Superfast Adjusted		Total
			23 Months or LESS	24 Months +	
readiness Increase	Increased	Count	42	37	79
		% within Superfast_Adjusted	36.8%	30.3%	33.5%
	No Change	Count	52	69	121
		% within Superfast_Adjusted	45.6%	56.6%	51.3%
	Decreased	Count	20	16	36
		% within Superfast_Adjusted	17.5%	13.1%	15.3%
Total		Count	114	122	236
		% within Superfast_Adjusted	100.0%	100.0%	100.0%

6.2.9 Summary of change between arms

The following table details the change before vs after in Readiness score for each arm of the study.

Table 6. Summary of readiness change between study arms

Intervention	readiness Change
Superfast Early	+0.26
Superfast Late	+0.21
No Booklet	+0.23
Booklet	+0.24
No GP	+0.17
GP	+0.29

6.2.10 Modelling

A univariate general linear model was conducted to investigate the main effect of the three intervention conditions (Superfast, Booklet, GP), added as fixed effects, on the change in eHealth readiness. A full factorial interaction effect was also examined between Superfast*Booklet*GP for the outcome of change in readiness.

Analysis of the model showed no significant main effect of either Superfast ($p=.677$), Booklet ($p=.928$) or GP ($p=.237$) on the change in Readiness scores.

There was also no significant interaction effect between each of the interventions (all $p>.05$).

Tests of Between-Subjects Effects

Dependent Variable: readiness change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.314 ^a	7	.759	.998	.433
Intercept	13.239	1	13.239	17.408	.000
Superfast_Adjusted	.133	1	.133	.174	.677
Booklet	.006	1	.006	.008	.928
GP	.917	1	.917	1.206	.273
Superfast_Adjusted * Booklet	.000	1	.000	.000	.984
Superfast_Adjusted * GP	1.471	1	1.471	1.935	.166
Booklet * GP	1.423	1	1.423	1.870	.173
Superfast_Adjusted * Booklet * GP	1.701	1	1.701	2.237	.136
Error	173.398	228	.761		
Total	192.000	236			
Corrected Total	178.712	235			

a. R Squared = .030 (Adjusted R Squared = .000)

Similar models were also conducted on each of the PERQ's sub-variables (Personal, Provision, Economic, Support) to analyse whether any of the

intervention conditions, singly or in combination, had impacted on certain aspects of eHealth readiness. These models were all non-significant ($p > .05$).

A final model was conducted on a simulated dataset to include missing values. On households with only one measurement, at either baseline or follow-up, the cluster average at that measurement point was substituted for the missing value. This provided a complete data set of $n=511$. The same model was repeated and again showed no significant main effect or intervention effect on Readiness scores ($p > .05$).

6.2.11 Health Related Travel

On matched households, the most common method of transport to visit a GP remained as 'Drive in own vehicle' with (154/253, 60.9%) with 29.2% (74/253) walking or cycling and smaller numbers having a lift in family/friend's vehicle (12/253, 4.7%) using public transport (9/253, 3.6%) or taking a taxi (3/253, 1.2%). The proportion of households reporting to drive to their GP did not significantly differ from baseline (154/253, 60.9% vs 156/256, 60.9%, $p > .05$).

Households' number of visits to their GP in the previous year remained similar to baseline, with a mean reduction of less than one visit per year (4.5 vs 5.2, $t(251)=1.13$, $p=.26$). The change in households' GP visits was compared between intervention arms and indicated that there was no significant reduction in GP visits between booklets (-0.6 vs -0.9, $t(249)=-0.18$, $p=.86$), GP intervention (-0.3 vs -1.2, $t(249)=-0.71$, $p=.49$) and Superfast (0.0 vs -1.5, $t(249)=1.15$, $p=.25$).

Using the process outline in Chapter 4, travel distances were calculated for each round-trip visit to GPs. Households travelled an estimated total distance of 3099 miles over a total of 1145 visits, with an average travel distance of 12.3

miles per year, this did not significantly differ from baseline (12.3 vs 13.0, $t(251)=.44$, $p=.66$). Total car miles accounted for 2666 miles, with these 'driving households' ($n=169$, drive in own car, lift from friend/family or taxi) travelling further on average each year when compared to 'Non-driving' ($n=84$) households (15.8 miles vs 5.2 miles, $t(251)=3.32$, $p=.001$).

GP car travel accounted for an estimated 613.2 kg of CO₂ over the previous year for the 169 driving households, an average of 3.6 kg/CO₂, this figure was identical to the baseline average.

CHAPTER 7. DISCUSSION

7.1 Changes across Cornwall in eHealth readiness and eHealth inequalities

The aim of this study was to assess the impact of the rollout of superfast and two randomised interventions on eHealth readiness and eHealth inequalities. The evidence on whether they were effective or not will be discussed later. First the overall changes in eHealth readiness and internet use will be considered. Most postcodes within Cornwall increased in readiness, with only 10 reducing in eHealth readiness. This finding suggests that, compared with the start of the study, Cornwall as a county was more ready to use and adopt eHealth. As might be expected within the current climate of rapidly increasing national internet adoption, this study showed that over the 18-month study period internet use within households across the county had increased (78% vs 82%). This increase is concurrent with the pattern of internet use within the UK which has increased year on year [210]. A total of one in five non-users had started to use the internet at follow-up. In comparison, only five individuals, less than three percent, had stopped using the internet.

Users displayed a similar pattern of eHealth use throughout the 18-month period. The most prominent activity remained searching for health information using a search engine such as Google. There was no significant increase in the use of social media to either obtain health information or contact a healthcare professional or organisation. No responder reported using Twitter for health information and only 2% of online households reported using Facebook. The low percentage of users using social media for health is interesting in the context of other research. A recent study [211] suggested that over 40% of

individuals who currently don't use social media for health would be interested in adopting it if their healthcare provider used it. A paper published in 2013 [212] found that 31% of internet users had used social media for health related activities, this was not supported by the responses within the current study, however as this study was conducted within the USA it is difficult to draw comparisons. The infrequent use of social media for health in Cornwall highlights that this is a potentially underused service in the area. This trend appears to continue nationally with the reach of social media being limited as evidenced by the low number of followers, page likes, and subscribers to health organisations social media pages [213]. These results suggest there is a mismatch between the openness to use social media for health and the actual use of the service. As social media use is becoming so prevalent, it is vital that health organisations consider how to use it to their advantage to both inform and engage their patients.

Considering there is inevitably a link between internet use and eHealth readiness, it is reasonable to argue that the increase in the proportion of internet users is responsible for the observed increase in eHealth readiness. However, when new users were excluded from the analysis, the increase in readiness was still significant. The higher proportion of internet users alone did not account for all the increase in eHealth scores. Suggesting that internet users got better and more ready to use the internet for health.

EHealth readiness within households in Cornwall had significantly increased during the 18 months. Over a third of households showed an increase in their readiness, half showed no change, and the remaining showed small reductions. Importantly, eHealth inequalities within Cornwall remained similar despite the increase in readiness. This would either be because the increase in readiness

was similar across the whole spectrum of households in Cornwall or the measure used was not sufficiently sensitive to find a difference with this sample size. It is not purely that the previously most proficient users had improved significantly in readiness, but rather individuals from across the whole 'scale' had shown improvements.

To summarise there was a measurable increase in internet use and eHealth readiness across all postcodes within the study. This increase in eHealth readiness was not explained only as an increase in new users of the internet but also in more extensive use amongst existing users. While the overall eHealth readiness increased, it did not seem to be at the expense of greater eHealth inequality.

Readiness scores are created through a combination of sub-variables including Personal, Provision, Support and Economic. Both Personal and Provisional 'scores' increased significantly over the 18 months and were responsible for the change in eHealth readiness, with Support and Economic variables remaining similar. The significant increase in Personal scores suggested that internet users within Cornwall are now more confident at using the internet, with non-users more willing to try using the internet. This is supported by the significant increase in self-reported confidence at using the internet for health-related tasks. With Provision scores increasing it indicated that individuals had more opportunities to access online health information, either by improved or increased methods of access or increased online health resources via GPs or national institutions.

This is apparent when considering how and where individuals had accessed the internet, with a significantly higher proportion using their mobile devices in addition to their home and work computers. This increase has been predicted

and has been shown nationally [214]. This growing trend has implications in the context of its impact on eHealth service delivery and availability. It is vital this is used in future eHealth research, with regards to planning, provision and interventions. Based on the follow-up responses, 64.8% of internet users were using their mobile devices to access the internet. It is possible that this will soon become a large majority's primary access point for the internet and health services. This raises several important questions for eHealth service providers, namely: (i) Are the currently provided eHealth services accessible and fully useable on mobile platforms? (ii) Are eHealth services able to effectively make use of apps? The NHS app library was used in the intervention, which listed and reviewed recommended health apps, but it was discontinued in 2015. Currently there is no centralised location for patients to visit which would inform them of recommended and reliable health apps. Instead patients must currently rely on peer reviews to judge the reliability and accuracy of the app.

On the other hand, both Economic and Support scores showed no significant changes. Regarding Economic scores, this would imply that the relative cost of the internet had not become cheaper or more expensive for individuals to access, despite the increase in device options (e.g. mobile). To some degree this result was expected, the introduction of superfast broadband across the county was not designed to reduce the costs faced by the users. The cost would be higher for individuals choosing to uptake the service. With mobile devices becoming more prevalent there is a suggestion that they can be used to help bridge economic barriers towards eHealth [215 216], however this was not reflected in these findings and was not a focus of the research project.

The non-change in Support scores would suggest that the support structure available to facilitate access to eHealth resources remained similar within

Cornwall. Certain barriers highlighted within the literature review regarding poor support [94] are likely to have remained in place for several individuals. Socially isolated people within Cornwall may still struggle to gain benefits of eHealth use. The lack of change in Support can be considered in the context of other findings from the study. As discussed, there had been no increase in the number of individuals using social media for eHealth. Social media may provide an ideal platform for healthcare professionals to communicate with the public, to assist with queries, or to direct individuals to helpful information. This avenue could provide increased support for internet users but again non-users would struggle to use the service.

The pattern of change among these sub-variables could be encouraging for potential interventions or future research. Arguably the Provision of eHealth services and a person's ability to access them (Personal) are currently the most malleable to change and are the main areas which inventions can be focussed. EHealth services can be implemented and made more accessible, certainly a vast amount of research has focussed on the effectiveness and benefits of specific eHealth services [13] and pushed for wider availability. The increase in mobile use and coverage of the internet may provide access to a greater number of people [217]. Individuals can be educated regarding eHealth and trained on how to use a specific service, for example [218 219]. With internet use increasing in general, the next generation of individuals are likely to be more able to use the internet for healthcare.

Whereas the economic viability of the internet and the support structures in place to aid its use may require a more holistic approach to implement change. Studies have shown that even the poorest can use and gain benefits from the internet should the correct support structure be in place [217 220]. Many have

started to argue that access to the internet is a 'social right' as opposed to a luxury. In future, the Government may have to examine whether a subsidiary should be provided to aid the most at risks groups' access and use the internet. Research can provide evidence of effective support structures and lay the foundation for continued support. Maintaining these structures will require an external organisation to ensure their longevity.

7.2 Effectiveness of interventions

7.2.1 Superfast intervention

As described in the methods the rollout of superfast broadband was a natural experiment; there was no opportunity to randomise postcodes but it was included as one arm in this study. There was no significant difference in the change of Readiness scores, between early and late receivers, during the 18-month period. Based solely on this result this would indicate that the superfast rollout had no impact on individuals' readiness for eHealth. The numbers of individuals who either increased or decreased in readiness over the 18 months was also consistent between arms, which lends further support to this finding. However, analysis of additional categorical responses would suggest that it not as simple to state that the superfast rollout had no impact on Cornwall as a county. There was a significant increase in the number of households reporting that they were happy with their broadband speed, this was shown on both unmatched and matched households. Late receivers showed a significant increase in the proportion of households reporting increased happiness with their internet speed, moving from 'too slow' to 'fast enough'. This result is understandable at face value, the PhD project gained approval after the Superfast Cornwall project had already begun to rollout the fibre infrastructure.

It is likely that areas classified as early receivers already had access to superfast broadband and therefore were more likely to be happy with their speed. Late receivers gained access to superfast broadband during the study, so were more likely to be unhappy at baseline then happy with speeds when measured at follow-up. This response may also depend on the expectations on an individual's expectations. As they get used to the greater speed/bandwidth their use increases and their expectations also increase. Therefore, those who had superfast at the beginning of the study may already want more speed by the end of the study. Those who had only recently got their superfast may be (temporarily) happy for some months or a year, until they also start to increase their speed expectations and think that they need faster broadband.

Regarding eHealth readiness, there was a positive correlation between the number of months which superfast had been available to a household and their Readiness score, with increased months available correlating with higher Readiness scores. However, there was no correlation between the change in scores and superfast months. The positive correlation suggests a link exists between superfast broadband and eHealth readiness however, it is difficult to extract a causal relationship. If superfast had led to improved readiness, it would be expected that this result would have been evident at both baseline and follow-up. Early receivers would have shown significantly higher eHealth Readiness score at baseline when compared to late receivers. In addition, late receivers would have shown significantly higher increases in eHealth readiness compared to early receivers. The analysis did not show these outcomes and was not able to demonstrate a causal relationship.

The correlation between readiness and number of months at superfast does warrant further thought and is difficult to interpret. One explanation might be

due to the pattern of the superfast rollout, with urban areas tending to receive superfast earlier. In these situations, the areas who had superfast for longer were more likely to be urban areas and less socially isolated, and therefore may 'naturally' have higher initial Readiness scores, although this would be expected to have been highlighted in the baseline results. It is possible, and likely, that the actual correlation is with time itself, over time the number of months superfast has been available would increase, if eHealth readiness is naturally increasing with time you would expect to find this correlation. The correlation does suggest a link but with the data available it is difficult to examine the magnitude of this link and the true relationship between these variables, and should be considered with caution.

It is important to remember that the superfast broadband intervention sought to analyse the impact of installing a high-speed fibre infrastructure in the area and not purely the impact of those who took up the service. An individual is unlikely to gain benefits of the superfast intervention unless they had adopted the service by upgrading their internet or potentially switching their supplier. At the point of follow-up BT's estimated uptake of superfast broadband within Cornwall was quite low at 28%.

This means that roughly only one in four households within superfast areas, are using the service. It was not possible to obtain data on which households had or had not adopted superfast broadband, therefore it was not possible to conduct 'as treated' analysis. Potentially households who adopted the service may show significantly higher Readiness scores. This raises an important question as to why the uptake of superfast is low, even with the service being available for years in certain areas. This is reflected nationally, with Ofcom [221] reporting that, by the end of 2015, only 42% of households across the UK

had taken up offered superfast services. This figure is higher than Cornwall's but it is important to remember that superfast has been available in other parts of the UK for much longer. The low uptake figures have been widely reported in the media with numerous articles reporting that the increase in cost has prevented people from switching to the service [222]. However, empirical research supporting this claim has not been identified and it was not reflected in the results of the current study. If the cost had become a large concern it would be expected that it would have been observed in households Economic scores. The proportion of households who reported that the cost of monthly internet was a concern to them remained at 38% at both baseline and follow-up. This figure would be expected to have increased if it was the only reason for non-uptake of superfast services.

Arguably one of the most important findings is households' responses regarding their perceived barriers to eHealth access. With the option of 'I would use eHealth more if I could get a good internet connection' being the least selected response. Only three households reported this as a barrier at follow-up. From this response, it is apparent that individuals do not perceive their current internet speed to be a barrier to eHealth use, or at least not the most significant barrier. There are understandable explanations for this; arguably no online health services currently available in Cornwall require a superfast broadband connection. Considering the reported use of eHealth services, the most common was using Google to search for health information. Much of online health information is in simple text and picture format and does not require a high-speed connection to use. Very low numbers reported using health services which are potentially more dependent on higher speeds, such as YouTube (<5%). A pattern which continues nationally, the NHS YouTube

channel has less than 26000 subscribers. Furthermore, even if video streaming was being used regularly for health information, this can still be achieved with lower speed connections of 500+ Kpbs [223].

However, there is the potential for health services to use higher speed connections, particularly with regards to high definition live video consultations. Such services would require a high-speed connection for both download and more importantly upload speeds. If GPs or hospitals within Cornwall were offering such services, the observed result may have been significantly differently.

In the current Cornwall context, having lower speed internet was not a significant barrier to eHealth use or readiness. Therefore, the rollout has not had a significant effect on eHealth readiness. The rollout has had a measurable impact in household's general perception of speed and, from an infrastructure stand point, Cornwall has undergone a large change. This has not translated to measurable results regarding significant increases eHealth Readiness scores. As a county Cornwall is structurally more ready to adopt eHealth services, it can support HD live streaming, video calling etc. throughout the county, but until these services become available we cannot predict its 'true' impact on individual's readiness to use those services.

7.2.2 Booklet intervention

The booklet was designed to increase several aspects of eHealth readiness, with the aim to increase the overall Readiness score of its receiver. A key area of focus was the individual's ability to access eHealth opportunities and their knowledge of available resources. In the case of non-users, it sought to provide

guides and learning resources, and for users it provided information on how and where they could find and use online health information.

There was no significant difference between those who had and those who did not receive a booklet. When compared to control conditions, individuals who had received a booklet did not show any significant changes in their Readiness scores or the sub-variables which contribute to its calculation. In addition, there was no significant measurable effect on categorical responses which, if successful, should have been impacted by the tailored booklets.

Providing information of eHealth services both locally and nationally did not improve receivers' Provision scores. Individuals did not appear to have used the recommended sites listed in the booklet. With the proportion of responders reporting that they had 'been able to find what they are looking for' or 'been able to contact health organisation', when searching for health information, remaining similar between arms. One focus of the booklet was to make individuals more knowledgeable about the online services which their local GP provides. It was hoped that this would prompt users to make use of these services. However, the proportion of individuals selecting 'Don't Know' or reporting use of the available services also remained similar between intervention arms. Furthermore, this proportion remained similar for all responders over the 18-month period, which would suggest that both knowledge and use of online GP services had not changed within Cornwall.

The training sections within the booklet attempted to improve an individual's ability to access health information and the internet in general, however no significant differences in Personal scores were shown. In addition, other measures, such as Skill and Confidence scores, did not improve for internet users. These individuals did not show measurable improvements in their ability

and confidence to use the internet and eHealth. The proportion of new internet users (from non-use to use) did not differ between receivers of the booklet, essentially non-users did not attempt or were not able to make use of the internet training material in the booklet. Non-users showed no improvement in their Support scores, which would be expected if they had contacted or visited support services which can help facilitate internet use, such as UKOC.

Combining this specific information into a booklet was not effective. It is possible that sections of relevance were 'lost' among the other information in the booklet but it is more likely the booklet was not sufficient to delivery impactful information.

The actual knowledge of receiving a booklet was extremely low at follow-up with only five households reporting they had received a booklet. Furthermore, even individuals who received Personalised (named) and highly tailored booklets, did not show better recollection of the intervention compared to those who received basic tailoring (location). The process of tailoring did not appear to significantly improve the relevance or usefulness of the booklet to the individual. There are several explanations for this, either, once the booklet is delivered it is not even read by the individual or it is perceived as junk mail and is immediately disposed of. Alternatively, the booklet itself may have no longevity, it was not impactful enough to 'stick' in the receiver's mind and result in a measurable and sustained change in behaviour. The follow-up measure took place roughly six months after the intervention phase of the study, it is possible that if this measure had been conducted closer to the intervention memory of the booklet would be higher. This may have also shown in other areas such as an improvement in GP service knowledge, website use and changes in eHealth readiness. Although this argument is essentially irrelevant, if the booklet

intervention has no longevity past six months then, by itself, it is not effective at achieving sustainable change.

This raises an important question regarding the delivery of this information moving forward. Arguably altering the source of this information may have a greater impact. The booklet contained an official logo from Plymouth University in an attempt to increase the trust of the provided information. However, a university organisation is not closely associated with an individual's personal healthcare, potentially having this information provided by healthcare professionals may increase the use and acknowledgment of the booklet. As opposed to delivery via the mail, which can often be saturated, these booklets could be provided within a GP surgery or directly via a GP or healthcare professional. This method would become a form of information prescription, which has had promising results [224]. Instead of focusing purely on a specific illnesses or condition that the patient has, the booklet instead would take a holistic approach to eHealth use and provision in general. In this example, the healthcare organisation would act as a trusted gateway to knowledge, signposting individuals to reliable health information.

During the GP intervention, sample booklets were provided to the GPs to give an example of the other intervention taking place at the household level. In limited discussions, the GPs expressed an interest in the booklets and suggested they would be willing to accept GP specific booklets into their surgery. These GPs were keen to create their own information page specific to the GP which could be added using the same tailoring process. However as stated these were limited 'passing' statements recorded in the researcher's diary, without further research it is not possible to predict the actual willingness to adopt and the effectiveness of these booklets.

Based on the results it is apparent that the booklet intervention in isolation is not effective at increasing eHealth readiness. Receivers are either not reading, using or remembering the content within the booklet. If it is a case of not remembering, there is the potential that a sustained campaign involving multiple booklets would show a more significant impact. However, this process would not solve the issue of receivers who ignore or do not perceive the information as useful. It was hoped that the process of tailoring would make the booklet more relevant to the receiver and therefore increase its memorability. Based on the limited memory of receiving the booklet reported at follow, this was unsuccessful. As discussed, the source and delivery of this information may alter the perceived usefulness, with information prescription showing promising results for health management. In its current design the booklet intervention is not suitable to be adopted as a standardised approach to improve eHealth use and readiness.

7.2.3 GP intervention

The GP intervention was designed to achieve two main outcomes (i) Encourage GPs to adopt more eHealth services (ii) Encourage GPs to actively promote existing services to their patients, and aid them in adopting such services. Achieving these outcomes should have impacted patients within the area, resulting in increased eHealth readiness and use.

The GP intervention appeared ineffective at achieving the two desired outcomes. A simple measure was used to assess the services offered by GP surgeries prior to the intervention, and then repeated at follow-up. This indicated that there was no noticeable increase in service provision in GPs within the intervention arm of the study. A total of six GPs within Cornwall had

started to offer online access to medical records at follow-up, previously none, however again this did not differ between arms.

There were no significant differences in household's eHealth readiness, or contributing sub-variables, between receivers and controls. Like the booklet intervention, the GP intervention also showed no significant impact on categorical measures which were targeted. Households within the GP intervention arm did not show increased awareness regarding local GP services. Essentially intervention GPs had not significantly increased the promotion of their services, or this promotion had no impact on the surrounding areas. Furthermore, the proportion of responders reporting that a healthcare professional had provided them with information regarding online health use did not differ between the GP arms of the study. Therefore, GPs did not adopt or increase their provision of information prescription, a topic covered in the intervention meeting.

Examination of 'as treated' responders, from areas surrounding GPs who participated in the intervention, also showed no significant changes in outcome measures. All GPs, who met with the researcher, were negative about the potential use of a phone triage system, which had been championed by some GPs [209]. Many GPs elaborated by mentioning a recent article in the Lancet [225] that had shown increased workloads within surgeries using a phone triage system. This suggests that GP surgeries will monitor research to help inform decisions regarding the implementation of new services. This highlights the importance of continued research in this area as it can serve to inform both a GP's attitude and behaviour towards eHealth. Continued research into the effects of services such as online access to medical records may highlight significant benefits and demonstrate the feasibility of its widespread adoption.

Published research in this area is much more likely to be effective as opposed to a short, isolated meeting with a lone researcher.

Where the researcher could attend larger practice meetings, it was apparent that the views and opinions of GPs differed drastically within the same surgery. In one meeting of note, the topic of information prescription 'sparked' a large debate over its usefulness. Several GPs within the practice were very positive towards information prescription, often directing patients to specific URLs with information on their condition and even printing out online information for those who had limited access. On the other hand, two GPs had very strong views against using information prescription, raising concerns that they didn't trust the information available and preferred that the patient spoke to them only and not use the internet. This discrepancy in GPs attitude has been well documented [226], and highlights the continued inequalities of service provision. When previously discussed, GP provision was considered as one level of access based on the assumption that all patients of the same surgery would have similar provision available to them (e.g. website, repeat prescription). However, this example highlights a potential further level of inequality based solely on GP allocation within a practice. Patients within this surgery experience completely different levels of support in accessing online health information essentially based on 'luck'.

The GP intervention was limited in that it struggled to recruit GPs to take part in the study, with only eight agreeing to have some form of contact with the researcher. The difficulty at recruiting GPs has been demonstrated in previous research [4]. The GP intervention was designed to prevent this, by being short in length with minimal requirements for GP participation, although this did not seem effective. The time of year may have prevented a higher participation

rate, with many GPs citing a busy flu season impacting their availability.

However, it is likely GPs will always be busy [227] and reluctant to participate without keen indication of potential benefits.

GPs who agreed to a researcher visit during the intervention phase already provided a high level of online services. In discussions, the GPs seemed quite open to eHealth and monitored research in the area, many cited the unavailability of technologies as a barrier to them adopting services such as video consultations and medical records. This highlights a further problem attempting to use this method of intervention. Responding GPs are more likely to be those most open to research or the adoption of new services and processes. This creates a form of self-selection bias, GPs who have no interest in eHealth and no desire to expand their offered services are much less likely to agree to take part in studies in that area. This is a concern moving forward, arguably these GPs are the 'most important' to contact and attempt an intervention, but it is apparent that the method used in this study would not be effective. This raises an important question of how researchers can design and undertake effective interventions with this group, as they are unlikely to aid significantly in the process.

Addressing barriers to the implementation of eHealth technology is a complex process that requires support from health services. It is important for policy makers and hospital or practice managers to understand the specific barriers that challenge the practicing GPs and design appropriate interventions to address barriers and promote facilitating factors [159]. This may be achieved through running in-depth interviews with the users to learn what specific barriers challenge the practice. This knowledge will allow for the development of tailored interventions by practice and allow for specific implementation plans. It is also

important to note that some barriers to the adoption of eHealth technology by healthcare professionals are not within the control of implementers [159]. Such barriers include high cost associated with the adoption and maintenance of eHealth technology. To overcome this barrier, government incentives may be required [74].

7.2.4 Intervention summary

Although eHealth readiness increased over the course of the study, this change could not be explained by the interventions. Singly, the interventions were not effective at increasing eHealth readiness and reducing eHealth inequalities.

Further analysis was conducted to explore any potential combined effect of the interventions, which also showed to be non-significant. As previous literature highlighted, individuals often experience multiple barriers to eHealth use. It was hypothesised that a combination of interventions, which addressed multiple barriers, would show the most significant improvements in eHealth readiness. Adopting this approach would suggest that a failure in one intervention could limit the effectiveness of the other interventions.

Arguably eHealth readiness could be considered in a 'tri-pod model'. The use of eHealth relies on three separate but supporting dependencies, essentially the legs supporting the tri-pod. EHealth requires (i) the personal ability to use it, (ii) the presence of systems to provide it and (iii) the infrastructure available to support it. In this setting, a weakness in one of these areas would prevent the increase of eHealth readiness regardless of improvements in other areas. It could be argued that, despite the lack of conclusive evidence, Cornwall is more eHealth ready because of the superfast project. Noticeable changes have occurred which have been detailed above, and Cornwall is now structurally able

to adopt improved services moving forward. However due to the ineffectiveness of personal and provider side interventions, this potential has yet to be realised. In the context of a tri-pod structure, superfast Cornwall has strengthened one leg but weaknesses remain in the other two supporting legs. Until these are also addressed no significant change is likely to be shown.

7.3 Health related travel

Health related travel measured in trips to GPs and hospitals, remained similar during the 18 months of the study. This was consistent across the all arms of the study, which indicated that the interventions separately and in combination did not significantly impact on health-related travel. As the interventions were not specifically targeted to reduce travel this result is not unexpected, travel was measured as a secondary explorative investigation. The study was not able to show a correlation between an individual's eHealth readiness and the number of trips to taken to visit a healthcare facility. Without this link being identified it was highly unlikely that the interventions would have shown any significant impact on travel, had they altered eHealth readiness.

The predicted link between health-related travel and eHealth readiness was based on two main assumptions. Firstly, the argument that an individual who is more eHealth ready can avoid unnecessary travel to both hospitals and GP surgeries. This individual may use the internet regularly to look up health related topics and manage any pre-existing conditions, potentially avoiding travel for minor health concerns. They may use forums to discuss health topics with fellow patients, or contact a health professional directly via e-mail.

However, the opposite may also be true, one significant predictor of eHealth use is an individual's health. People with pre-existing or long term conditions

have an increased interest in finding out more about their condition and monitoring their own health through internet services [228]. Many responders, 11%, listed that “they had no need for health information” as a barrier to eHealth, should these individuals become ill their use may increase but also their required travel to health institutes would increase. In this example, the correlation would show the opposite of the original assumption, in that increased eHealth use would be linked with an increase in travel.

A second assumption was that an individual who is more eHealth ready, in that they are computer literate and a regular user of existing eHealth services, would be more ready to adopt a new service such as video consultations. This assumption has good face validity, and if true, would show a reduction in travel correlated with an increase of eHealth readiness. However, this is reliant on such a service being implemented and available to be used. As previously discussed, no such service was, or became, available within Cornwall during the 18-month study and was not provided by any of the interventions.

Therefore, the potential to measure this impact was not in place. There are certainly examples from existing research that show the potential for eHealth services to reduce car travel [33-38]. To use many of the discussed systems users would require a fast and reliable broadband infrastructure. Such an infrastructure is now in place within Cornwall, therefore it can be argued that Cornwall has much more potential to ‘realise’ these reductions. This is particularly important within Cornwall due to its rurality and strained transport links with healthcare services.

The first step of this process requires a link between eHealth readiness and travel to health services to be established. Currently this is purely ‘face value’ and has not been shown decisively in research. It is apparent that someone

with home internet has more possibilities to adopt a service which could reduce their health-related travel, compared to a non-using counterpart. However just because an individual uses and has access to the internet does not mean they will choose to use the internet for health [92]. It is reasonable to hypothesise that an individual's eHealth readiness plays a role in their likelihood to adopt, the magnitude of this role needs to be assessed.

7.4 Choice of PERQ as outcome measure

7.4.1 Sensitivity and appropriateness

The PERQ was originally constructed to measure improvements in eHealth readiness and eHealth inequalities. This was because it was argued that existing measures such as the eHealth Literacy Scale (eHEALS) [122] were inadequate because they have moved away from that basic principles the of digital divide and limitations of access to the internet. With validation studies [124] highlighting that eHEALS relationship with internet use, and expected relationships with age, education, and actual performance, were weak.

In the original work on PERQ designed to serve as a measure of both eHealth readiness and inequalities, and to assess the effectiveness of interventions in this area. Statistically significant changes in mean scores must represent practically (clinically) significant changes, and vice versa. Namely that the scale must be sensitive enough that clinically significant changes are reflected in a significant change in score.

The PERQ had previously been piloted [70], within this paper modelling illustrated its potential ability to assess change. Sections had also been included in other measures to assess elderly individual's ability to use the internet [200]. However, this was the first study to use the PERQ to assess

eHealth interventions. Which allowed for the assessment of the PERQ's validity, and suitability of the at measuring interventions.

By comparing clinical outcomes against significant changes in scores, it does suggest that the PERQ is valid. New internet users showed the most significant increases in eHealth readiness when compared to their counterparts. With individuals who stopped using the internet showing the most significant reductions. Responder's Provision scores showed significant improvement and is concurrent with the measurable increases in both internet speed and the usage of mobile devices to access the internet.

As previously discussed both the Economic and Support variables showed no change throughout the 18 months of the study. Given that no change was evident it raises the question as to whether these should be included in future, or if they need to be assessed in a different way. In the context of the study the lack of change is understandable at face value. The study did attempt to increase the support available to individuals in both the booklet and GP intervention, however these interventions ultimately showed to be ineffective at altering all the contributory sub-variables. There is the potential that an individual does not fully acknowledge the role of support in starting to use the internet for health. For example, although the booklet intervention in this study offered contact details of places where people could get help in starting to use the internet it is not clear if they took advantage of that or would recognise it if they did. In addition, there has been no noticeable programme or structural increase the support available to individuals in Cornwall in general. Therefore, it was unlikely that there would have been any significant impact on the Support variable. There have been no measured clinical outcomes which should have resulted in a significant increase of eHealth Readiness.

The interventions within this study were also not targeted to help alleviate the cost of the internet for individuals; therefore, it was unlikely that change would have shown against the Economic variable. The cost of using superfast broadband is higher than standard broadband previously available within Cornwall. Meaning, there is the potential that the cost of the internet should have become more of a concern for individuals who had adopted superfast, this should have been reflected in the Economic variable. However, without this information available it is difficult to effectively analyse, a simple comparison was performed on individuals who were happy with their speed against individuals who reported having slow internet, this showed no significant difference in Economic scores.

Despite the lack of change, it is perhaps too early to discount these two sub-variables without further research. A study which is specifically focussed on increasing the support available to an individual to both access and use the internet and eHealth would provide a better understanding on how effective this variable is at measuring support. Furthermore, as highlighted in the results section, one new internet user showed no increase in their Readiness score because the cost of their newly acquired internet had become a major concern to them. In this example, their Economic score had reduced significantly enough to out-weigh other increases that would have led to an increased Readiness score. This highlights that such a measurement is important and shouldn't be discounted. Further intervention studies are required to provide insight into whether the way these variables are calculated need to be changed.

In this study, significant increases were shown in the overall Readiness score and the Provision and Personal sub-variables. However, the significant increase in readiness was relatively small for a nine-point scale (CI=0.13-0.35).

As this is the first time the PERQ has been used to assess interventions it is difficult to quantify the magnitude of this change, but it highlights that the sensitivity of the PERQ may need to be assessed in future.

Unlike other measures in this area [122], the PERQ can be completed by both internet users and non-internet users, therefore the most 'at risk' populations is not discounted from study. The responses from both internet users and non-internet users closely mimicked nationally reported statistics on internet use, which provides further face validity to the measure. From a practical standpoint, the study has shown that the PERQ can be incorporated into a repeated measure design, before vs after. The response rate achieved in this study was lower but close to that of the initial pilot (28.7% vs 34.2%). This highlights a potential estimated response rate of 30% for future studies using a similar delivery design, much higher than other community-based surveys, response rates of 10.5%, for personalised, and 7.5% for generic [229].

Despite the discussed issues, it is apparent that the PERQ is suitable to assess eHealth interventions and could be more widely adopted moving forward with additional studies in this area. Where clinical changes had occurred, the PERQ showed significant increases and decreases in eHealth Readiness and sub-variable scores. The PERQ is appropriate for interventions in this area as it can be incorporated into RCT designs, used as a before and after measure. It was sensitive enough to highlight significant changes within Cornwall during the 18-month period. The magnitude of this change on a nine-point scale has been discussed and is difficult to quantify without further research. Further research and modification on the PERQ will help refine and improve the validity of the measure.

7.4.2 Additional use and further research

The PERQ showed potential to be used as a diagnostic measure. At follow-up, retrospective analysis was conducted on individuals who had stopped using the internet. This indicated that these individuals had significantly lower Readiness scores at baseline when compared to other internet users. Essentially the PERQ seems effective at identifying an 'at risk' population. This can be used to intervene earlier and more effectively with this population. It is likely to be much more difficult to switch a non-user back to user once the decision has been made to stop, as opposed to facilitating the use of a 'wavering user'.

The diagnostic potential of the PERQ was further highlighted in the intervention phase of the study, with the creation of tailored booklets. The tailoring process used information available from the PERQ to attempt to effectively target towards the receiver. Even though the booklet intervention was not shown to be effective, this potential should not be discounted. This tailoring could focus in different areas, for example showing GP surgeries if patients in their area are aware of the services they provide. Or used to assess which individuals may be suitable for a specific intervention such as community computer training.

The study showed how the PERQ can be modified to measure additional variables. Questions were added to assess health-related travel and to 'trap' responders contact details for the follow-up study. Such a process can be repeated in future studies, responses already captured within the PERQ could be used to generate additional scoring systems. A separate scoring system could be developed to give specific continuous variable of a responders' internet use in general.

This study has highlighted that, along with national trends, the use of mobile devices to access both the internet and eHealth services has increased and is expected to continue to increase. The PERQ may have to be altered to take this into consideration for future research. Currently the PERQ only measures mobile use in the context of being a point of access to the internet. However, this may be limited giving the increased use of Apps for healthcare, for example diet trackers, smoke free apps and blood pressure monitors. If the PERQ is not expanded, it is possible that an individual who is highly eHealth ready, using numerous health apps, may show a low Readiness score as they may not equate this to online internet health use.

7.5 Implications for NHS policy

As part of the 'Digital First' [8] policy the NHS detailed its ambition to "become a world leader in digital healthcare delivery, surpassing the successes and capabilities of other organisations already delivering digital healthcare". At a primary care level, initiatives included appointment booking, pre-assessment tools, remote follow-up, and online access to medical records. A further pledge was delivered by Jeremy Hunt, the Secretary of State for Health, stating that 95% of patients would have online access to GP records by 2015 [230]. Based on the results of this study this pledge has not been realised within Cornwall, with only seven (less than 10%) of GP practices offering online access to medical records at follow-up. This target appeared to be 'missed' nationally, with reports of the pledge being scaled back [231], and only 3% of practices offering this service at the end of 2015.

More recently, performance figures from the NHS stated that in April 2016, over 95 percent of GPs could offer patients online access to their detailed health

record [232 233]. However, as this figure is 'grouped' with online appointment booking and repeat prescriptions it is perhaps a little 'misleading' in the context of patients having the ability to access their record. This reported figure highlights the seeming disconnect between the NHS high-level targets, and its actual translation to patient use and benefit. Having the ability for GP practices to offer online services differs significantly from usage, and the realisation of benefits for both staff and patients. At the close of 2016, approximately 10.4 million patients were signed up for online services [234] representing just 19% of the 54.3 million NHS England serves [235].

The aim for the NHS policy of moving towards a more digital service is to the enhance the provision of healthcare to patients while maintaining a manageable service. Findings from this study, indicated that even individuals who are signed up may not actually be aware or use the services on offer. Knowledge and use of services remained similar during the 18-month period, despite nationally reported improvements. This would suggest that to achieve a digital NHS, lower level plans must be implemented and included within the NHS high-level policy. A shift must be made towards policies that include effective patient engagement to encourage and increase the use of services which are already on offer. This can coexist with current pledges to increase the 'structural availability' of services.

CHAPTER 8. CONCLUSION

8.1 Limitations of the study

8.1.1 General methodology

The study suffered from several methodology issues. A few 'general' limitations associated with this design and well documented will be discussed briefly, with study specific limitations warranting deeper discussion. The study did not implement a form of single or double blinding. Responders were aware if they had access to superfast broadband and if they had received a booklet in the post. This had the potential to introduce bias into the study, for example the simple fact of knowing superfast broadband was available in the area may have led responders to perceive their internet as faster or more accessible. No form of double blinding took place, due to the design of the study it was necessary for the researcher to know which arm a responder was a part of, this allowed for the tailoring of interventions. Analysis was also conducted by the researcher who had knowledge of the intervention group allocations; although no conscious bias was introduced by the researcher it is not possible to discount a form of unconscious bias which may have altered the significance of the analysis. Measures were taken to reduce this risk, including review by university colleagues, however due to their knowledge of the research it is possible this bias was maintained.

The measure required self-report by responders which raises several limitations. Self-reporting often introduces the problem of over-estimation [236], responders may over estimate their skill or adherence with an item on the questionnaire. This was shown in the initial trial of the PERQ [70] with ceiling effects being reported on self-estimated confidence scores. Furthermore,

responders often show errors in self-observation and may have inaccurate recall [237], both reduce the validity of responses regarding trips to and distance from local GPs. Finally, the wording of questions or its position within the questionnaire could be detrimental to gaining accurate responses [238]. The PERQ had been previously trialled and modified [70], and was further edited and reviewed prior to the baseline survey in an attempt to reduce this bias.

The study suffered from a low response rate and, in combination with the self-report measure, potentially introduced a form of participation or non-response bias into the results. Essentially the results reported in the study may not be fully representative of Cornwall as responder's may disproportionately possess certain traits compared to non-responders which may affect the outcome. This was highlighted in the baseline chapter purely from a demographic stand point; responders were disproportionately female, older and came from areas with higher estimated house values. As an individual's economic status has been shown to be a barrier to eHealth, the noted lack of response from less affluent areas is of concern to the study. A main aim of the research was to help reduce inequalities in eHealth use, with the inability to involve this population it is likely those most at risk may not have gained any benefit. The study showed a significant increase in eHealth readiness with inequalities remaining constant, however without the data from those most socially deprived there is the potential that this group showed no change and may now actually suffer a greater inequality. It is vital that further research modifies the method of data collection or focuses solely to engage this group, or there is a risk that these will continue to be 'left behind'.

In addition, there is the potential of other characteristics beyond that of an individual's socio-demographic status, which may not have been captured. Responders in general may be more interested in eHealth or, in the case of non-users, may be more interested in learning to use the internet. Furthermore, as the PERQ is text based it requires basic literacy skills which would have again discounted an at-risk population.

8.1.2 PERQ measure

This was the first study to use the PERQ to assess the impact of eHealth interventions. The PERQ is still a relatively new measure, as such it makes generalisation of these results in a wide context difficult. For this reason, it is difficult to quantify the magnitude of change within Cornwall and to precisely place this impact in the national setting. Comparison with existing research has been discussed to overcome this limitation. Furthermore, it is possible that the sensitivity of the PERQ and the method of variable creation should be altered but this requires further research to accurately assess this.

The results of the study have further highlighted the increase in mobile usage to access and use the internet. With the reported increase in mHealth this is an area which may be lacking within the current PERQ measurement. The PERQ does not consider the use of mobile applications within its questionnaire and for this reason mHealth usage within Cornwall is likely to have been overlooked during this study.

8.1.3 Interventions

The identified literature highlighted that there was a lack of theory driven interventions, and that future interventions should be designed based on a clearly defined implementation theory. This study attempted to design interventions, with their basis in theory, using aspects of the diffusion of innovations. However, this approach may have been limited in its scope. Changing both professionals and individuals use and opinions of eHealth inevitably involves a form of behaviour change. Precise behaviour change methodologies were not clearly specified in the design of the interventions. The study may have benefitted by adopting a more modern framework such as the Behaviour Change Wheel [239]. This framework enables researchers to define the desired behaviour; identify the appropriate intervention and identify the supportive policy categories.

The interventions in the study had specific limitations which must be considered. The superfast broadband rollout was outside of the control of the researcher and was not able to be manipulated, as such was this arm was a 'natural experiment'. This means it was not possible for the researcher to control for bias, as an example several the larger towns in Cornwall received superfast broadband first, due to the required infrastructure and number of individuals it would reach. This introduces an element of bias in that these urban areas were more likely to receive the intervention earlier than their rural counterparts. Therefore, a larger proportion of 'early adopters' were more likely to be from urban areas. Although it is important to note that this was not reflected in the baseline comparison of housing values, which provided a limited insight into the socio-demographic status of the superfast arm.

In addition, it was not possible to have a fixed control for superfast broadband for the 18-month period of the study. All the postcodes within the study were

due to receive superfast broadband therefore no comparison could take place on receivers of superfast vs non-receivers. EHealth readiness did increase over the course of the 18 months, however without having a fixed control it makes it difficult to determine whether superfast was responsible for this increase or whether it was natural over time. To overcome this limitation, the study sought to analyse early vs late receivers based on information provided by Superfast Cornwall. Analysis of the final dataset from Superfast Cornwall indicated that their initial estimated rollout schedule was largely inaccurate, this meant a re-categorisation of postcodes was required at follow-up. Postcodes were categorised based on months superfast had been available in their area, in some cases early and late receivers differed by just two months. The close divide between intervention arms means that it is difficult to notice significant differences between the responders. This increases the probability of a type II error occurring, in that a significant effect which is present has not been identified.

However, if you consider the responses regarding the speed of the internet it lends credibility to the allocation. A higher proportion of early receiver households reported having an internet connection that was fast enough for their needs at baseline when compared to late receivers. At follow-up, later receivers showed a significant increase in 'fast enough' speeds, which was not shown in the early receiver group. This suggests the study was successful at creating a noticeable split in the categorisation and reduces the potential that a type II error occurred.

The intervention at GP level was also limited, both in time and the content of the meeting. The intervention was designed to take a small amount of time in the hopes it would be more appealing to GPs and lead to a greater response rate.

Because of this the scope of the meeting was reduced to a few topics. With hindsight, the GP intervention should have included the topic of social media, as highlighted in the discussion chapter patients are relatively accepting of using social media for health. However, this is underused by healthcare providers, arguably a social media presence is much easier to adopt as opposed to some of the other topics covered within the meeting. It was very unlikely that GPs would be able to adopt and implement a form of video consultation within the time frame of the study, and such a service is likely several years away from being feasible at the GP level, an opinion echoed by the GPs in the study. Arguably using this section to discuss the use of social media within the practice, would have been more useful and may have led to a noticeable outcome.

The GP intervention used aspects of the diffusion of innovation theory in its design, this included using examples of early adopters to highlight benefits and demonstrate the feasibility of implementation. For this intervention to be effective it was vital that receivers could draw comparisons with the early adopter examples. The topic of patient access to medical records was discussed using the example of Haughton Thornley Medical Centre which implemented the service to help alleviate patient fears following the Harold Shipman prosecution. In one meeting a GP reacted passionately against this topic and refused to see any potential in medical records because Haughton was an “isolated case which was incomparable with other GPs”. This was an oversight by the researcher in the design of the intervention, it is apparent that GPs would not draw comparisons with that surgery due to the history and reasons behind the service implementation regardless of any benefits. Future

interventions must ensure that the examples provided are relatable to allow receivers to draw comparisons.

Finally, during the GP intervention the NHS information prescription service was recommended to GPs as a simple website which can be used to prescribe or direct patients to online information. During one meeting with a GP, who was an advocate of information prescription, it was relayed that in their opinion the quality of the NHS page was poor and Patient.co.uk was a much preferred and useful option.

8.1.4 Lack of a pilot study

The lack of a pilot phase limited both the GP and booklet intervention. A smaller pilot with local GPs may have provided insight into how to improve the response and participation rate of Cornwall GPs within the study. In addition, it may have highlighted comparability issue, such as those encountered with using Haughton Thornley Medical Centre as a relatable case study. A pilot phase with GPs could also have informed the contents of the booklet intervention. As previously mentioned, GPs within the study showed concerns with the information prescription service and demonstrated that patient.co.uk was a preferred and higher quality eHealth resource. As the concerns with IPS were only noted during the intervention phase, it was 'too late' to retrospectively alter the booklets sent out to households.

As the booklet intervention had no pilot phase it is difficult to identify the specific reasons for its failure. The low 'remembrance' rate indicated that the booklet had no lasting impact on participants. This could be due to the participant either simply not reading/disposing of the booklet, or may be due to how the information was presented or delivered. Potentially trialling the booklet with a

focus group of both users and non-users could have provided insight into which information was relevant or useful and which information could have been removed. In addition, a small local pilot could have been undertaken to examine to impact of method of delivery on 'remembrance' rates. Results from the baseline, and previous studies [70], showed higher response rates when the researcher could speak and hand deliver a questionnaire to participants. It is likely using this method to deliver the booklet would increase the likelihood that an individual would read the booklet and remember its contents. Logistically this would not have been possible during the scope of this study with the additional limitation of a solo researcher but should be considered for future interventions.

8.1.5 Randomisation and the sampling method

As the superfast rollout was outside the control of the researcher, it was not possible to randomise between all intervention conditions. The lack of randomisation could have introduced a bias into the comparison of superfast vs control. The installation of the fibre infrastructure was under the control of BT, although this phased rollout did eventually cover ~99% of households with Cornwall, the initial rollout included the 'easier to reach areas'. The early receivers were likely from areas in Cornwall which had existing internet infrastructure, and were less rural. For the rollout to reach highly rural and isolated areas, it naturally had to begin with installing sufficient infrastructure within the larger Cornish towns. Therefore, it is possible that late receivers contained a higher proportion of isolated households. Meaning there is the potential that a confounding and unmeasured variable is responsible for any noted differences between early and late receivers.

The sampling method was designed to reduce the potential of contamination between arms of the study. This was achieved by removed postcodes with shared GP practices following selection. This process introduced a form of ordering bias into sample selection. The selection of postcodes was ordered by population, a limited measure of rurality, meaning that postcodes which shared a GP practice with another more populated postcode, had a much lower chance of being selected. Although this approach prevented the random selection of postcodes, it was vital to reduce the high risk of contamination between intervention conditions. Adopting a purely random selection would have led to postcodes, which shared the same GP practice, being allocated to different treatment arms, e.g. Control vs GP intervention. This would have made it impossible to analyse the impact of interventions in isolation.

Mapping software was used to create a database of Cornwall with all the required information to begin sample selection. This database was constructed using data from various external sources outside the control of the research and limited the accuracy of this method. GP data such as; in operation surgeries, parent practices and locations, was acquired using an export of the NHS choices database. It was discovered retrospectively, during the intervention phase, that large portions of the database were out of date and inaccurate. Certain aspects did not significantly impact the study, such as incorrect contact details and GP names which were updated using Google searches. However, in some instances this did have a detrimental effect on the study, one GP had to be eliminated from the intervention phase as it was not a 'traditional GP' but rather a specialist centre for homeless individuals. In addition, there were several slight inaccuracies regarding the location of surgeries, with three having an address up to one mile away from the initial recorded location. This meant

the estimated distance to predict travel was not accurate, and may have altered the listed nearest GP to several postcodes.

Ordnance survey (OS) mapping data obtained from EDINA Digimap was used to create a visual map of Cornwall and a list of all postcodes within the county. This was linked with population data gathered from the 2001 census. This data was used to eliminate postcodes with zero population or with no data available. As this database was out of date the precision of this data was limited and led to 2958 postcodes being eliminated. It is possible that a few of these postcodes now contain population and are recently developed. Therefore, potential new household estates were not captured using this sampling method. Data regarding superfast rollout was provided by Superfast Cornwall, this detailed the 'progression' of fibre installation at the time of sampling. As previously discussed, Superfast Cornwall were unable to accurately predict rollout which limited the ability to predict late receivers. As evidenced by the results chapter, some postcodes initially listed as late receivers started to receive superfast at the time of sampling. This required a reorganisation process to ensure the accuracy of results.

Finally, distances to the nearest GP for each postcode were calculated using straight line distances from the centre of the postcode to the GPs location. Although this provided a strong estimate as to the nearest GP and the distance to that GP, there were inevitable some discrepancies. Three postcodes nearest GPs were located across a body of water leading to significantly greater travel distances when calculated using Google Maps. In these cases, it is possible that the identified closest GP did not actually serve the sampled postcode and less likely that responders from these postcodes visited the sampled GP. Meaning any intervention at these GPs was unlikely to have impacted the

corresponding postcode. Straight line distances were used mainly due to the large number of postcodes within the initial sampling frame (20088). Running route analysis on this number of postcodes would have required significantly longer calculation time in terms of computer processing. In addition, route analysis requires in depth knowledge of ArcGIS (mapping software), this was above the ability of the researcher at this stage and would have require a significant timeframe to learn the process, which was out of scope for the PhD project.

Regardless of the discussed limitations with the sampling method, it was still effective at producing a manageable sample size which significantly reduced the potential of contamination between arms of the study. In addition, in many cases it was successful at selecting responders nearest GP (as evidenced by Figure 9, Chapter 4). The discussed method can be improved upon to include route analysis earlier in the process and control the data input into the process, making it feasible for additional studies.

8.1.6 Analysis

Responders within this study encompassed both independent and repeated measurements. Simple analysis was conducted on all measurements before vs after to provide an overview of change within Cornwall. This analysis treated the measurements as independent, however as stated this dataset contained both independent and repeated measurements. This method is not statistically robust but was used purely to provide an overview of change within Cornwall. As analysis on matched households also supported the same significant findings it is unlikely this initial high level analysis provided any false positives but still must be considered with caution.

8.2 Contributions to knowledge

8.2.1 Intellectual contribution

This PhD is the first study to analyse the impact of a superfast broadband implementation on eHealth use and readiness. Previous research has examined the impact of having access to internet vs non-internet users [60-62]. Several papers have noted that 'poor' broadband may be a barrier to eHealth adoption [64 65 68]. However, the impact of improved reliability and speed has not been assessed or researched in a rigorous trial. At face value this assertion is certainly valid, internet services require data to be passed between systems and the infrastructure in place is responsible for the speed and reliability of this transfer. Each service requires a minimum connection speed to function effectively, when these speed requirements are not met systems will have reduced usability and may not work. This would prevent the users of the service from adopting and achieving any potential benefits. As technologies improve the minimum internet speed requirement is increasing [240] if eHealth services mimic this trend, to an extent which surpasses the supporting infrastructure, inequalities of access are likely to occur.

The superfast broadband project within Cornwall provided an opportunity to assess the impact of a significantly improved infrastructure. As the results and discussion chapters have demonstrated, significant changes have occurred in the county. Cornwall now has an increased proportion of internet users and higher eHealth readiness, however neither could be explained as a definitive outcome of the superfast rollout through comparison of early and late receivers. The implications of these findings have been explored within the discussion

chapter. In the context of the current climate of eHealth this PhD demonstrates that broadband infrastructure is not a significant barrier to eHealth use.

The second contribution is the sampling method used in this study, a method used to reduce contamination between study arms was innovative. The interventions affected a large geographical area which carried a large potential for contamination between arms. The use of mapping software, to identify shared GPs and the process of elimination to randomise allocation, has not been identified in any other published research. Such a method can be used for future research in which an intervention in one location has the potential to affect much of the sampling frame. This has use both within health research and beyond, for example a similar method could be used to examine the effects on wildlife relating to mapped water supplies such as ponds. For health research this method can be greatly improved upon, the use of network analysis can be introduced to calculate actual travel distances at an early stage as opposed to purely straight line distances, this would increase the accuracy of measurements. If larger samples are required, the process can be altered to select two or more clusters from the same practice area. Furthermore, researchers could instead acquire catchment areas of GP practices and implement this into the mapping software to precisely detail the serving GP of a postcode.

A further contribution is that this was the first study to use the PERQ to measure eHealth interventions. The PERQ has shown to be a promising measure of eHealth readiness and inequalities. Further research is required to refine and improve the PERQ. Wider usage of the PERQ will also allow for comparisons across publications to be drawn, and enable researchers the ability to quantify the impact of their intervention in relation to others. This study has also

demonstrated the potential of the PERQ to be used as a diagnostic measure allowing for the potential identification of at risk populations. Or to identify potential barriers towards an individual in view of tailoring an intervention towards them, in a similar method to the booklet intervention.

8.3 Future research

Various opportunities and recommendations for future research have been suggested in the discussion chapter, this section will seek to summarise and further elaborate on the potential for future research.

8.3.1 eHealth within Cornwall

This study has provided two measurements of eHealth readiness within Cornwall over an 18-month period. There is the potential to continue this study to provide a longitudinal view of the change in eHealth readiness over the coming years. A continued longitudinal study will provide insight into both the change over time and allow for the impact of the superfast rollout to be further assessed. As discussed, the actual uptake figures of superfast broadband are low, estimated at 28%, but these are expected to increase over the coming years. Continued measurement may show a continued increase in eHealth readiness as the uptake rates increase. Importantly it will also allow for the inequalities in readiness to be monitored, in this study inequalities remained similar, should uptake increase there is the potential for a larger divide to occur.

With the implementation of superfast across the county, Cornwall has the potential to be a prime location for research into eHealth. The infrastructure improvement has made it possible for Cornwall to support highly demanding eHealth services such as video consultations, or live streaming of health clinics.

Presently the county does not provide such systems, but now has the structural groundwork for research in this area. There is the potential for RCT trials of such services to be organised and conducted. Small trial projects might have to be conducted at the hospital level to show feasibility. This research will help show the potential benefits of such services, which may encourage innovations to be adopted more widely, such as at GP level. In addition, future research in the area will provide further insight into the significant barriers towards eHealth use, with the 'physical' speed barrier removed, other personal and organisational barriers are likely to be further highlighted. This will help researchers examine how to address those barriers and design effective interventions.

This PhD took a quantitative approach to examine eHealth readiness. Within both the results and the intervention phase several interesting case studies have been identified which would be suitable for a qualitative study. Several individuals started to use the internet over the 18 month study, a qualitative design would be able to examine the reasons why these individuals decided to adopt the internet after previous non-use. Understanding these reasons will help researchers design interventions which may be more suitable for non-users. Conversely a few internet users had stopped using the internet, interviews with this population will help identify barriers that can prevent the continued use of the internet and may allow for at risk individuals to be identified early.

There is also the potential for provider side qualitative research. Within the time limited meetings that the researcher attended several conflicting views were noted, further in depth interviews will allow for a greater understanding of the basis of these disparities. Understanding the views of the 'more reluctant' GPs

may provide answers on how best to approach and highlight the potential benefits of eHealth provision. During the study a total of seven practices started to provide online access to medical records to their patients, these seven GPs represent early adopters of the service in the county of Cornwall. Contacting these GPs will allow researchers to understand why the practice decided to uptake the service and to investigate the ease/difficulty of its implementation and any perceived benefits. Based on aspects of the diffusion of innovation, demonstrating these to practices in the area, either using a similar methodology to this PhD or through publications, could lead to wider adoption across the county.

8.3.2 Interventions and the PERQ

This was the first study to use the PERQ to assess the impact of eHealth interventions. As discussed, the PERQ has shown to be a promising and suitable measure of readiness moving forward. Areas of potential modification and improvement have been suggested within the discussion chapter, to fully use the PERQ's potential it is vital that the measure is adopted within future intervention studies. Based on this PhD the PERQ does appear valid as a measure of intervention studies however more research is needed to further validate its effectiveness and ensure that it remains a 'current' in the changing climate of technology and eHealth. As an example, the PERQ may have to be altered to consider the rise of m-health and analyse the use of health apps which may currently not be captured. Further studies will allow for the sensitivity of the PERQ to be examined in detail and may provide alternative methods of accurately examining both the Economic and Support variables. Irrespective of this, the PERQ has shown to be sensitive enough to capture significant readiness changes. In addition, it has demonstrated its ability to be

altered to capture additional variables, such as travel data, which increases its usability across topics.

The results of this study also demonstrated the PERQ's effectiveness to be used as a diagnostic tool. Moving forward this has the potential to be used in research in two separate but supportive methodologies. Firstly, in combination with a longitudinal study the PERQ can be used to monitor and highlight a potential 'at risk' population allowing researchers to intervene early. Secondly the PERQ could potentially be used as a sample identification tool, for example researchers may wish to identify individuals within a population who suffer the largest inequalities and seek to recruit them to a specialised intervention.

8.3.3 Travel

EHealth services have shown to have the potential to reduce health related travel [33-38], however many papers analyse purely the cost and time savings with the impact of reduced carbon emissions often unreported. This PhD has highlighted a simplistic method of calculating the carbon emissions of health travel, such an approach could be adopted and performed on existing data from eHealth studies in an independent systematic review.

At face validity, there is inevitably a link between eHealth readiness and health related travel. This link has yet to be demonstrated rigorously in research, as an example, a RCT of video consultations may highlight the reduction in travel and emissions however researchers need to consider the early stage of individual's decision to adopt the service or partake in the trial. Potentially individuals who choose not to use the service or show the least benefit from the RCT will also be those with the lowest eHealth readiness. Once this link is

established it will provide insight into the potential effectiveness of interventions in a pragmatic setting.

The reduction in carbon emissions should become a standardised analysis for interventions focussing on reducing visitations to health institutions. The method within this PhD was limited due to its pragmatic setting, trips were calculated on the assumption of a round trip with carbon estimates based on an average CO₂ per car mile travelled of newly registered cars since 2002.

Environmentally focussed research could use more precise tools to accurately measure CO₂ emissions.

Cornwall as a county is a 'prime location' for travel research. Due to its rurality and aged population it has the potential to gain significantly from reduced travel. Moreover, with the superfast rollout it is now structural ready to adopt many of the services which can reduce health related travel. Research should initially focus at the hospital level, which will show the largest and most significant potential to reduce miles travelled. Should these reductions show to be significant, it will increase the potential of this service to be adopted at a more local level, such as among GP practices.

8.4 Reflection on the PhD process and lessons learned

I entered the PhD process straight from a BSc in Psychology. This degree provided me with a 'solid' understanding of research process, methods, ethics, analysis, and the approach to conducting research. Prior to commencing the PhD I had a limited understanding of what to expect but was confident with my background education. However, it was quickly apparent the degree to which a PhD represents a significant 'step up' from all previous educational experiences. In traditional learning or courses, I was often provided with clear

learning objectives, a set road-map to follow and clear milestones. With a PhD, I started with a question that I needed to research and a timeframe of three years of funding. From this start I was responsible for every aspect of conducting the study, from reviewing the literature through to analysis and drawing conclusions. I was provided with experienced support from supervisors to help guide you in this process, but ultimately all decisions had to be made by me and I alone had to be able to justify these decisions.

Over the years of the PhD it is incredibly difficult to measure all the lessons learned, however a number do stand out. Firstly, the level of planning, research and thought that goes in to, and is required, for every single decision. For all sections of this thesis, there are numerous decisions or 'routes explored' that did not make the final edit but was vital for informing the final approach.

Undertaking this process over the years of study, significantly improves many 'soft skills' which are vital for all careers, such as logistical planning or making informed decisions based on evidence.

Personally, one of the most significant lessons I learned over my PhD is that in research there is no perfect approach. This is particularly true for pragmatic research, i.e research that takes place in the 'real world' as opposed to a laboratory. Much of the literature on RCT's describes highly controlled environments which are open to manipulation by the researcher. In the case of this study, numerous variables were outside my control, the Superfast Cornwall project was in progress and rapidly accelerating towards completion. From the start of the PhD it always felt as if I was trying to 'catch up', in an ideal setting I would have been involved from the start of the rollout and had the ability to allocate areas to receive Superfast broadband. This was never a realistic option and would rarely be so in a research setting. With hindsight, if I was to

conduct the research again I could have explored alternative approaches to GP interventions and how information within the booklet was delivered. However, at the time the decisions made were justifiable based on the literature and the logistical limitations, therefore I would not categorise them as mistakes.

Ultimately, considering everything I have undertaken over the course of the PhD, it has taught me the difference between theoretical approaches to research and the actual 'real-world' practicalities of research. This has further highlighted the importance of reflecting upon the study, understanding its limitations, highlighting key findings and finally detailing and publishing these so that other researchers can progress the topic of study without repeating ineffective decisions.

8.5 Summary of key findings and importance of the research

This PhD project aimed to assess the impact of three interventions on eHealth readiness (i) improvement of physical infrastructure (Superfast Cornwall); (ii) tailored booklets to households providing information to help improve personal skills in eHealth; and (iii) discussions with GP practices to encourage greater use of the internet in health service provision.

EHealth readiness significantly increased during the 18-month trial however this increase could not be explained by the interventions under investigation.

Individuals within Cornwall are now more ready to adopt eHealth services and have increased in both their personal ability to use services and their methods of access to those services. Importantly this increase has not caused a larger digital divide within the county with inequalities remaining similar.

The increase in eHealth readiness suggests that individuals appear to be heading in the right direction regarding using the internet for health. However

ultimately this body of work failed in its attempt to identify replicable interventions which could help reduce the inequalities of eHealth use and provision. Of the three interventions discussed it is likely that the mass rollout of superfast broadband had an impact on Cornwall. Despite the low uptake figure reported by BT, there were measurable changes in speed perception and happiness. In the current climate, these changes did not translate to significant improvements in eHealth readiness, likely due to the lack of services in the area. The installation of fibre broadband has planted the basis for Cornwall to potentially benefit in future, arguably pre-emptively removing a future barrier.

This PhD has further highlighted the difficulty researchers face to design and administer effective interventions, both at the individual and institutional level. The researcher struggled to recruit GPs to take part in the intervention phase of the study, and had no impact on those that agreed to partake. In addition, the tailored booklets failed to be memorable or noticeable to receivers and had no measurable impact. One major problem faced by researchers in this area is the lack of interest of individuals to change behaviour. Poignantly, the overwhelmingly reported reason for non-use of the internet was “I have no interest in the internet”. This again raises the question, if current mostly aged individuals are unwilling to adopt the internet and if internet use is generally increasing year on year, should researchers attempt to intervene? Or rather wait until the temporary phenomenon fades away with successive generations?

This is not an unreasonable argument, younger generations in general have had more experiences with technology and will be more familiar with the internet compared with the current generation. However, perhaps the most important statistic from this research is not the increase in the proportion of internet users and eHealth readiness, but the fact that five individuals stopped

using the internet. Due to the exponential development of new technologies, the differences between older and younger adults' use of new eHealth systems are likely to be trans-generational. To prevent major inequalities in healthcare provision it is vital that effective interventions which help reduce the digital divide, with regards to eHealth, are identified and developed. As eHealth technology increases within healthcare and more technologies and studies evaluating the use of these technologies emerge, it is important that current barriers and facilitators to their adoption and implementation are updated.

This PhD attempted to develop replicable and effective interventions, in their current form these interventions are not suitable. Nevertheless, aspects of these interventions should be considered moving forward. Individuals possess different levels of eHealth readiness and experience a wide range of separate and shared barriers, it is unlikely that a standardised intervention will be effective across the board. Interventions will require a form of tailoring grounded in theory, to achieve this aim. This process is likely to require a significant effort beyond that of the capabilities of a lone researcher. Research has its place to help solve this problem but must inform and requires a 'push' from larger organisations with larger reach and funding. As a society, it is vital that there is a drive to develop strategies which go beyond short term gains and instead achieve sustainable use and adoption of eHealth.

APPENDICES

Appendix A. Literature Review search strategy

Selection Criteria

Systematic reviews and meta-analyses which focused on eHealth interventions (particularly involving internet based technology) and which described a systematic approach to the identification, selection and inclusion based on quality assessment.

RCT studies which involved an eHealth intervention (particularly involving internet based technology) and were conducted after systematic reviews in its intervention area.

Reviews and RCTs which did not contain any internet-based interventions (i.e. telephone support) were eliminated.

The search was limited to post 2000 and studies in English language.

Search Dates

An initial literature search was conducted in March 2014.

A subsequent search was conducted in July 2016 to identify and further papers which had been published since this date.

Section: Examining the potential benefits and limitations of eHealth

Search Terms

Ehealth or e-health or telemedicine or telehealth or internet-based or computer-based or web-based IN TITLE

AND impact* or effect* or outcome* or advantage* or benefit* or reduce* or limitation* Systematic review IN TITLE

AND internet or online or web* IN ABSTRACT

Main results

Total papers identified: 1384

After duplicates removed: 430

After elimination by title: 277

After elimination by abstract: 121

Systematic: 34*

RCT: 87*

**Further examination of the remaining papers identified Ekeland et al [13] Effectiveness of telemedicine: a systematic review of reviews (2010). This review contained many the identified systematic reviews which gave confidence that the search terms used were appropriate. After reading this paper it was decided to further eliminate reviews to papers published after Ekeland et al[13]. Papers prior to this were discussed in the context of Ekeland et al [13].*

Final Results

RCT: 25

Systematic: 12

Section: The digital divide and barriers to eHealth

Search Terms

Ehealth or e-health or telemedicine or telehealth or internet-based or computer-based or web-based IN TITLE

AND inequalities or digital divide or lack of access or barriers IN TITLE

AND internet or online or web* IN ABSTRACT

Main results

Total papers identified: 855

After duplicates removed: 358

After elimination by title: 105

After elimination by abstract: 45

Section: Measuring eHealth inequalities

Search Terms

Ehealth or e-health or telemedicine or telehealth or internet-based or computer-based or web-based IN TITLE

AND measure or readiness or literacy IN TITLE

Main results

Total papers identified: 214

After duplicates removed: 96

After elimination by title: 52

After elimination by abstract: 31

Section: Interventions to increase eHealth use and Provision

Search Terms

Ehealth or e-health or telemedicine or telehealth or internet-based or computer-based or web-based IN TITLE

AND acceptance or facilitation or increasing or barriers IN TITLE

AND internet or online or web* IN ABSTRACT

Main results

Total papers identified: 1213

After duplicates removed: 453

After elimination by title: 100

After elimination by abstract: 37

Appendix B. Economic RCT summary

Paper	Study Design	Sample	Intervention	Results & Key Findings	Comments
Ljotsson B, Andersson G, Andersson E, et al.(2011)[36]	RCT	61 patients with IBS symptoms recruited from a gastroenterological clinic.	Patients randomised to receive 10 weeks of ICBT guided by an online therapist (n=30). Waiting list control (n=31)	ICBT group demonstrated significantly larger improvements in IBS related outcome scales. ICBT found to be more cost effective than waiting list. 87% chance of leading to reduced societal costs. Sustained over 12 months.	Large dropout rate. Dropout rate seemed to be associated with severe and large impairment, would therefore only be effective for a subset of clinical patients.
Krukowski RA, Tilford JM, Harvey-Berino J, et al.(2011)[33]	RCT	323 overweight or obese adult volunteers recruited in two clinical centres.	In-person (n=161) behavioural weight control attended group sessions at the clinical site, starting with a cohort of 12–18 members. In-person group sessions lasted for 60 min and occurred weekly for 6 months. Internet condition (n=162) attended virtual group sessions in the form of a synchronous interactive “chat” on a secure website, starting with a cohort of 12–18 members. All interaction with the group leader was done electronically for Internet participants. Intervention “chats” lasted for 60 min and also occurred weekly. Both conditions had 24 intervention sessions over a 6-month period.	In-person had significantly greater weight losses however the life years gained was insignificant. Total cost for in person was \$706 vs \$372 \$2160 per LYG in internet condition vs \$7,177 per in-person group.	Difference mainly due to decreased travel cost \$158 per person When participant time costs are included in an economic evaluation of a behavioural weight loss intervention, Internet-based Weight loss delivery may be a more cost-effective approach to obesity treatment.
Hedman E, Andersson E, Lindefors N, et al (2013)[241]	RCT	81 participants with diagnosis of severe health anxiety. Self-referred or referred for psychiatrists and primary care physicians.	ICBT (n=40), treatment based on CBT model for health anxiety. 12 modules over 12 weeks, including access to therapist via online contact system. Control (n=41), online discussion forum between patients for 12 weeks.	ICBT associated with improvement in primary health measure. No significant effect of time suggests longevity. ICBT cost effective treatment with societal cost reduction of £1244	Analyse against control group, no analysis against none internet based CBT.
Sjostrom M, Umefjord G, Lindholm L, et al (2013)[34]	RCT	250 females aged 1-70, with stress urinary incontinence (SUI).	Randomised to 3 months of pelvic floor muscle training via either an Internet-based program including e-mail support from an urotherapist (n=124). Or a program sent by post (n=126)	Cost for internet treatment was higher per person (38.2€) compared to the postal group (6.6€) However using ICER costs were similar with internet based having slightly better outcome.	Increased cost but higher QALY gain. Would be more expensive but considered cost effective within national guidelines.
Andersson E, Ljotsson B, Smit F, et al (2011)[242]	RCT	Participants (N = 85) with IBS were recruited through self-referral and were assessed via a	The experimental group was given a ten-week internet delivered cognitive behavioural treatment with therapist support via e-mail.	Significant cost reductions were found for the treatment group at \$16,806 per successfully treated case. The cost reductions were mainly driven by reduced work loss in the treatment group. Results were sustained at 3-month and 1-year follow-up.	Internet-delivered CBT appears to generate health gains in IBS treatment and is associated with cost savings from a societal perspective.

		telephone interview and self-report measures on the internet.	Control group, took part in a discussion forum and could contact the therapist for general support.		
Hedman E, Andersson E, Ljótsson B, et al.(2011)[243]	RCT	Participants (n=126) with social anxiety disorder (SAD)	ICBT 15 weeks with access to online support from a therapist via secure messaging (n=64). CBGT one initial individual session followed by 14 week of group sessions (n=62).	Both treatments were equally effective at reducing social anxiety. Both generated savings that exceeded cost of intervention. ICBT cost less therefore more cost effective (main reduction in therapist resources)	Similar attendance rates. Didn't measure travel potential further savings, savings in time as well
Meer V, Hout WB, Bakker MJ, et al. (2011)[35]	RCT	200 participants recruited from 37 practices. Patients with asthma and inhaler.	Internet based self-management (n=101), including weekly monitoring of asthma control and lung function, immediate treatment advice according to a computerized personal action plan after completing the validated Asthma Control Questionnaire on the Internet, on-line education and group-based education, and remote Web communication with a specialised asthma nurse. Usual care group (n=99)	Costs of the Internet-based intervention were \$254 (95% CI, \$243 to \$265) during the period of 1 year. From a societal perspective, the cost difference was \$641 (95% CI, \$21957 to \$3240). From a health care perspective, the cost difference was \$37 (95% CI, \$-874 to \$950). At a willingness-to-pay of \$50000 per QALY, the probability that Internet-based self-management was cost-effective compared to usual care was 62% and 82% from a societal and health care perspective, respectively.	Internet-based self-management of asthma can be as effective as current asthma care and costs are similar
Warmerdam L, Smit F, van Straten A, et al (2010)[37]	RCT	A total of 263 participants with clinically significant depressive symptoms	Internet-based cognitive behavioural therapy (n = 88) Internet-based problem-solving therapy (n = 88) A waiting list (n = 87).	Cost-utility analysis showed that cognitive behavioural therapy and problem-solving therapy had a 52% and 61% probability respectively of being more acceptable than waiting when the willingness to pay is € 30,000 for one quality-adjusted life-year. When society is prepared to pay € 10,000 for a clinically significant change from depression, the probabilities of cognitive behavioural therapy and problem-solving therapy being more acceptable than waiting are 91% and 89%, respectively. Comparing both Internet-based treatments showed no clear preference for one or the other of the treatments	Both Internet-based treatments have a high probability of being cost-effective with a modest value placed on clinically significant change in depressive symptoms.
Os-Medendorp H, Koffijberg H, Eland-De Kok PCM, et al. (2012)[38]	RCT	199 Parents of children with moderate Atopic dermatitis (AD) or adults with moderate AD	Intervention group (n=101) patients had access to eczema portal including e-consultations, internet-guided monitoring and self-management training. The portal also contains general information about AD and personal information about prescribed treatment and daily skin care Usual Care (n=98) five scheduled follow-up visits to the dermatologist for diagnosis, monitoring and treatment during the first year, and at least one additional visit to the dermatology nurse for self-management training	There were no significant differences in disease-specific quality of life, severity of AD and intensity of itching between both groups at the three time points. Overall, individual eHealth was expected to save €594 (95% CI)2545 to 1227) per patient in the first year of treatment, mainly through a reduction in work absenteeism. Uncertainty analyses revealed that the probability of eHealth reducing costs was estimated to be ‡ 73%.	eHealth during follow-up of patients with AD is, after initial diagnosis and treatment during face-to-face contact, just as effective as usual face-to-face care with regard to quality of life and severity of disease. However, when costs are considered, eHealth is likely to result in substantial cost savings. Therefore, eHealth is a valuable service for patients with AD.

Appendix C. PERQ measure for study

**PLEASE COMPLETE THIS GREEN QUESTIONNAIRE IF YOU
'HAVE USED' THE INTERNET IN THE PAST 3 MONTHS
ID=1000**

A. INTERNET USE FOR ANY PURPOSE

This section is about whether you have used the Internet, how often and where you use it.

A1) Typically how often do you use the Internet for any purpose?

- Many times a day At least once a day
 At least once a week Less than once a week - every now and then

A2) What have you used the Internet for? *Tick boxes in the first column for all the ways you have used the Internet for any purpose, and tick boxes in the second column for all the ways you have used the Internet for something related to your health.*

	Have used the Internet for.....	
	Any Purpose	For something Health Related
To find information (e.g. using Google)		
Email		
Internet telephony (e.g. Skype)		
Discussion forum		
Twitter		
Social network site (e.g. Facebook, Linked in)		
Watching videos (e.g. YouTube)		
Online Gaming or Virtual World (e.g. World of Warcraft, Second Life)		

A3) Where and how have you accessed the Internet in the last 3 months? Tick all that apply

- Desktop / laptop computer at home Smart phone or mobile device (e.g. iPhone, iPad)
 Desktop / laptop computer at work Computer in a library or community centre
 'Paid for' computer in an Internet café, shop, airport
 Elsewhere

B. ACCESS TO INTERNET SERVICES

This section is about your access to the Internet and the services available to you.

- B1) Does your home (tick ✓ one).....
- Have an Internet connection that is fast enough for what **you need** (Go to B3).
 - Have an Internet connection that is slow for what **you need**
 - Have no Internet connection
 - Don't know
- B2) If you do not have an Internet connection, or it is slow for what you need, why is that? (tick ✓ one)
- I would need to pay more
 - I live in a rural area and there is no good connection to my home
 - My local server is congested and unreliable
 - My Internet provider does not offer a faster connection
 - Don't know
- B3) Does your General Practitioner (family doctor) have a website (e.g. that you might find by Google)?
- Yes I have looked at it
 - Yes I think so but I have not seen it
 - No
 - Don't Know
- If your General Practitioner (GP) has a website AND you have looked at it:**
- B4) If you wanted, can you order a repeat prescription by email, or on your GP's website?
- Yes, I **have** done so
 - Yes, but I have **not** done so
 - No
 - Don't Know
- B5) If you wanted, can book an appointment online to visit your GP?
- Yes, I **have** done so
 - Yes, but I have **not** done so
 - No
 - Don't Know
- B6) If you wanted, can you see your own medical record online via your GP's website?
- Yes, I **have** done so
 - Yes, but I have **not** done so
 - No
 - Don't Know
- B7) In the last three months, have you used the Internet trying to find information about **health** topics, services, treatments, advice etc?
- Not tried in the last 3 months
 - Tried, and found what I wanted most of the time
 - Tried, but not been able to find what I wanted
- B8) In the last three months, have you used the Internet trying to contact an organisation online, or discussion forum, or other people, for some reasons connected with **your health** and been able to get what you wanted?
- Not tried in the last 3 months
 - Tried and found what I wanted most of the time
 - Tried, but not been able to contact who I wanted

C. PERSONAL SKILLS, CONFIDENCE, AND SUPPORT IN USING THE INTERNET FOR HEALTH

This section is about your skills in using the Internet and if you could, or have, given support to others in using the Internet for health.

C1) Do you have a long term disability that makes using the Internet difficult?

- No
- Yes, makes using the Internet very difficult
- Yes, makes using the Internet somewhat difficult

C2) This question is a self-assessment of your Internet skills, not necessarily concerned with health. In the following table, please read the 'task' and then tick one box to show if you think you could do that task.

I think I could.....	No	Maybe	Yes
Book tickets for a film online and save a copy of the booking into a folder on your computer			
Go online to check symptom information from a trusted health source			
Use Google to find out what type of documents you need to apply for a new passport if yours was lost			
Locate healthcare facilities in my local area, then plan how to travel there			
Create an online social media page, upload photos into an album and comment on the photos			
Visit a forum to discuss health issues with others and/or professionals			

C3) In general how confident are you in using the Internet for **health related tasks**?

Circle a number between 1 (not at all confident) and 10 (totally confident).

Not confident.....Totally confident									
1	2	3	4	5	6	7	8	9	10

C4) In the past 6 months have you received a leaflet in the post regarding using the **Internet for health**?

- Yes
- No
- Don't Know

C5) Has a doctor, nurse, or other health professional ever given you information (e.g. a web address) to help you use the Internet for your health?

- Yes
- No
- Don't Know

C6) If you, or someone in your household, wanted help using the Internet, could you find it near where you live, or by phone or email? (e.g. from local library, Age UK, local authority, NHS, or University).

Not that I'm aware of Don't Know

Yes

If yes, have you ever made use of such help? Yes No

C7) Would you be willing to help a person in your local community use the Internet for their or their family's health by offering training or support?

Yes Yes but only over phone or email

No I don't think I have the skill to help No

C8) Have there ever been times when help from somebody in using the Internet for your or your family's health was or might have been useful for you?

Yes No

If NO to C8, go to section D

C9) Do you have a family member or friend who could help you to use the Internet (for any purpose)?

No Yes, there is someone I can ask quite easily

Yes, but they are not, or would not be very easy to ask

C10) **If yes to question C9**, would you feel OK about asking them to help you use the Internet for your or your family's **health** purposes (to find information or to communicate with someone)?

Yes

No

D. ECONOMIC CONSIDERATIONS

This section asks about the cost to you of using the Internet for health or of accessing health services.

D1) To get an idea of comparative costs, please read each of the statements and tick one box for each to show whether you agree or disagree, as they relate to you at the moment.

For me.....	Strongly agree	Agree	Disagree	Strongly disagree	Don't know
The monthly cost of home Internet is a major concern					
Mobile Internet access on smart phones and tablets (e.g. iPad) is expensive					
Getting to a public library to use the Internet does not cost much					
It costs me nothing, or very little, to get to see my GP					
It costs me nothing, or very little, to visit my nearest hospital					

E. OVERALL VIEWS ABOUT USING THE INTERNET FOR HEALTH

This section asks about the factors most likely to reduce your use of the Internet for health, and for your views.

E1) Which **one** statement best sums up how you feel about using the Internet for health? None of them may be exactly right, but try to choose **one** and then you can further explain your answer in the space in E2.

- I have no need for health information
- I don't understand the Internet that much
- I would use the Internet more for health if I could get a good Internet connection
- I would use the Internet more for health if more online health services were available to me
- I would use the Internet more for health if I could get someone to help me
- I would use the Internet more for health if money were no object
- I have or would use the Internet for health and have no real barriers to that use

E2) Do you have any thoughts about using the Internet for health? What could be done to help those who want access to the Internet for health? (Also use this space if you want to further explain your answer to E1).

.....

.....

.....

F. ABOUT YOU, HEALTH INFORMATION AND SUPPORT

This last section asks for information about you. Please note that all information will be held confidentially and securely.

F1) First Name: Last Name:

F2) Gender: Male Female

F3) Age: 16-24 25-34 35-44 45-54 55-64 65-74 75+

F4) As an estimate how far is it to your GP? (1 mile = 1.6km)

Less than 1 mile 1 – 3 Miles 3 – 5 Miles 5 – 10 Miles 10+ Miles

F5) How do you usually travel to your GP Surgery? (tick one only)

Walk or cycle Public Transport Lift from friends or family in their vehicle

Drive in own vehicle Taxi Other

F6) As an estimate how many times have you visited your GP in the past year?

F7) Have you had any hospital appointments in the last year?

Yes No

F8) If yes, how many?.....

F9) How would you normally travel to hospital?

Walk or cycle Public transport Lift from friends or family in their vehicle

Drive in own vehicle Taxi Hospital arranged transport

Other

F10) In the last three months have you (tick ✓ all that apply):

Seen a doctor, nurse, or other health professional about your health	
Asked a family member or friend something about your health	
Phoned a helpline (e.g. NHS Direct, Samaritans, Diabetes UK) about your health	
Read a book, or magazine to find something out about your health	
Used the Internet for something to do with your health	
None of the above	

**Thank you very much for taking time to complete the questionnaire.
Please return in the prepaid envelope.**

PLEASE COMPLETE THIS PINK QUESTIONNAIRE IF YOU 'HAVE NOT USED' THE INTERNET IN THE PAST 3 MONTHS

A. FOR PEOPLE WHO HAVE NOT USED THE INTERNET IN THE LAST THREE MONTHS

This section asks about if you have EVER used it, whether you would like to use the Internet, if maybe you would like to use it for health related things, given help.

- A1) Have you EVER used the Internet (for any purpose)? (Tick one of the following)
- I used to use it fairly often but not recently I have only ever used it a few times and not recently
- I have never used it
- A2) Do you have a long term disability that would make using a computer difficult?
- No Yes, makes using the internet very difficult
- Yes, makes using the internet somewhat difficult
- A3) Does your home have an Internet connected computer? Yes No
- A4) As far as you know do any of your neighbours have Internet access?
- Yes No Don't Know
- A5) Has anyone ever used the Internet for you (e.g. to find out something for you, or to buy something for you, or to contact someone on your behalf by email)?
- Yes No
- A6) If someone was able to help you, would you 'have a go' at using the Internet?
- Yes Probably Possibly No, it's not really for me
- A7) If you would 'have a go' using the Internet, do you have someone (e.g. family, friend, neighbour) who could help you?
- Yes, there is someone I can ask quite easily No
- Yes, but they are not, or would not be very easy to ask
- A8) If someone was able to help you, and it was easy, and it was cheap, would you use a home Internet connection?
- Yes Probably Possibly No
- A9) If there were Internet connected computers available at some place (such as the local library) that you go to, and they were free to use, easy to use, and there was help there to use them for any purpose, would you consider using them?
- Yes Probably Possibly No

B. ECONOMIC CONSIDERATIONS

This section asks about the cost to you of using the Internet for health or of accessing health services.

B1) To get an idea of comparative costs, please read each of the statements and tick one box for each to show whether you agree or disagree, as they relate to you at the moment.

For me.....	Strongly agree	Agree	Disagree	Strongly disagree	Don't know
The monthly cost of home Internet is a major concern					
Mobile Internet access on smart phones and tablets (e.g. iPad) is expensive					
Getting to a public library to use the Internet does not cost much					
It costs me nothing, or very little, to get to see my GP					
It costs me nothing, or very little, to visit my nearest hospital					

C. OVERALL VIEWS ABOUT USING THE INTERNET FOR HEALTH

This section asks about the factors most likely to reduce your use of the Internet for health, and for your views.

C1) Which **one** statement best sums up how you feel about using the Internet for health? None of them may be exactly right, but try to choose **one** and then you can further explain your answer in the space in C2.

- I have no need for health information
- I have no interest in using the Internet
- I would use the Internet more for health if I could get a good Internet connection
- I don't understand the Internet that much
- I would use the Internet more for health if I could get someone to help me
- I would use the Internet more for health if money were no object
- I would use the Internet more for health if more online health services were available to me
- I have or would use the Internet for health and have no real barriers to that use

C2) Do you have any thoughts about using the Internet for health? What could be done to help those who want access to the Internet for health? (Also use this space if you want to further explain your answer to C1).

.....

.....

.....

D. ABOUT YOU, HEALTH INFORMATION AND SUPPORT

This section asks for information about you. Please note that all information will be held confidentially and securely.

D1) First Name: Last Name:

D2) Gender: Male Female

D3) Age: 16-24 25-34 35-44 45-54 55-64 65-74 75+

D4) As an estimate how far is it to your GP? (1 mile = 1.6km)

Less than 1 mile 1 – 3 Miles 3 – 5 Miles 5 – 10 Miles 10+ Miles

D5) How do you usually travel to your GP Surgery? (tick one only)

Walk or cycle Public Transport Lift from friends or family in their vehicle

Drive in own vehicle Taxi Other

D6) As an estimate how many times have you visited your GP in the past year?

D7) Have you had any hospital appointments in the last year?

Yes No

D8) If yes, how many?.....

D9) How would you normally travel to hospital?

Walk or cycle Public transport Lift from friends or family in their vehicle

Drive in own vehicle Taxi Hospital arranged transport

Other

D10) In the last three months have you (tick ✓ all that apply):

Seen a doctor, nurse, or other health professional about your health	
Asked a family member or friend something about your health	
Phoned a helpline (e.g. NHS Direct, Samaritans, Diabetes UK) about your health	
Read a book, or magazine to find something out about your health	
Used the Internet for something to do with your health	
None of the above	

**Thank you very much for taking time to complete the questionnaire.
Please return in the prepaid envelope.**

Appendix D. Ethical Approval Baseline Survey



13 June 2013

CONFIDENTIAL

Philip Abbott-Garner
School of Health Professions
Faculty of Health, Education and Society
Plymouth University
4 Portland Villas

Dear Philip

Reference Number: 12/13-144

Application Title: Do superfast broadband and community interventions improve use of e-health and reduce health related car travel? Factorial cluster randomised controlled trial.

Thank you for submitting this application to the FREC. Before we are able to approve it we would like you to attend to the following:

1. Please identify, as part of the background, any other research based literature that has been published on this area.
2. Please state clearly as to how electronic data gained from questionnaire administration will be stored.
3. It should be made clear to potential participants that participation is voluntary.
4. The information sheet should state that participants can withdraw at any time, without providing a reason and without detriment to their relationship with the researcher or the university.
5. How will potential participants be informed of the URL for the web version of the questionnaire?

When you submit your revised application please indicate, in a separate attached letter, how and where you have responded to the above.

Yours sincerely

Professor Michael Sheppard, PhD, AcSS
Chair, Research Ethics Committee -
Faculty of Health, Education & Society and
Peninsula Schools of Medicine & Dentistry

Reference Number: 12/13-144

Application Title: Do superfast broadband and community interventions improve use of e-health and reduce health related car travel? Factorial cluster randomised controlled trial.

Please find the responses to the required changes below:

1. Please identify, as part of the background, any other research based literature that has been published on this area.

The background section of the ethics form has been further developed. In addition I have attached my RDC project overview highlighting research in the area.

2. Please state clearly as to how electronic data gained from questionnaire administration will be stored.

The following paragraph has been added to the Confidentiality section of the ethics proposal. "Currently an Excel database lists the selected delivery addresses alongside a corresponding unique ID. On return of questionnaires the name of the participant will be entered in an additional column, storing participant name against address. This database will be used solely for informing participants if they 'win' a voucher and addressing the follow-up survey using mail merge function. Responses to questions will be stored in a separate Excel database for analysis. Responses **will** be stored against a unique ID. Both databases will be separately password protected and stored on a password protected computer. To match named data with responses will therefore require three passwords. No data will be accessible outside of the research team."

3. It should be made clear to potential participants that participation is voluntary.

The line "Completing the attached questionnaire is voluntary and you are under no obligation to respond." Has been added to the covering letter that will be delivered to households.

4. The information sheet should state that participants can withdraw at any time, without providing a reason and without detriment to their relationship with the researcher or the university.

The section "You have the right to withdraw from the study at any point and can do so by contacting me at the details listed on the bottom of this letter."

Has been amended to:

"You have the right to withdraw from the study at any point without providing a reason and can do so by contacting me at the details listed on the bottom of this letter. Withdrawing from the study will in no way affect your relationship with the research team or Plymouth University."

5. How will potential participants be informed of the URL for the web version of the questionnaire?

A web URL to the online questionnaire alongside a unique ID is located at the top of 'Internet users' questionnaire. To make this clearer the line "If you would prefer to complete the questionnaire online a web link and unique ID can be found at the top of the questionnaire." has been added to the covering letter.

Thank you for taking the time to consider the ethics proposal

Yours sincerely

Philip Abbott-Garner

Appendix E. Ethical Approval Intervention and Follow-up



9th July 2014

CONFIDENTIAL

Philip Abbott-Garner
4 Portland Villas
Plymouth University

Dear Philip

Application for Approval by Faculty Research Ethics Committee

Reference Number: 13/14-259

Application Title: Do superfast broadband and tailored interventions improve use of e-health and reduce health related travel?

I am pleased to inform you that the Committee has granted approval to you to conduct this research.


Please note that this approval is for three years, after which you will be required to seek extension of existing approval.


Please note that should any MAJOR changes to your research design occur which effect the ethics of procedures involved you must inform the Committee. Please contact Sarah Jones (email sarah.c.jones@plymouth.ac.uk).

Yours sincerely

Professor Michael Sheppard, PhD, AcSS,
Chair, Research Ethics Committee -
Faculty of Health & Human Sciences and
Peninsula Schools of Medicine & Dentistry


Appendix F. NHS REC approval decision


Health Research Authority



MRC | Medical
Research
Council

Do I need NHS REC approval?

 To print your result with title and IRAS Project ID please enter your details below:

Title of your research:

Do superfast broadband and tailored interventions improve use of e-health and reduce health related travel?

IRAS Project ID (if available):

Your answers to the following questions indicate that you do not need NHS REC approval for sites in England. However, you may need other approvals.

Appendix G. Approval from the Royal Cornwall Shared Research Management Service

One + all | we care

Royal Cornwall Hospitals 
NHS Trust

Royal Cornwall Hospitals NHS Trust
The Knowledge Spa
Truro
Cornwall
TR1 3HD

RESEARCH AND DEVELOPMENT DIRECTORATE

Direct Dial: 01872 256421

Direct Fax: 01872 256420

Email: cornwall.research@cornwall.nhs.uk

18th August 2014
Mr Philip Abbot-Garner
4 Portland Villas
Plymouth University
School of Nursing and Midwifery
Plymouth
Devon
PL4 8AA

Dear Mr Abbot-Garner,

RM&G Reference Number: 2014.PRIMARYCARE.50

Study Title: Do superfast broadband and tailored interventions improve use of e-health and reduce health related travel?

Thank you for submitting your application for the above study for review by the Royal Cornwall Shared Research Management Service. We are pleased to confirm that this study complies with the Research Governance Framework for Health and Social Care. The Shared Research Management Service can provide assurance to primary care providers and pharmacies in Cornwall (covering the former Cornwall and Isles of Scilly PCT) that on the basis of the documentation submitted, the proposed research meets nationally agreed research governance criteria. This assurance can be used by primary care providers and pharmacies to decide whether to take part in this research study.

This assurance is provided on the basis that the following standard conditions are met:

- Compliance with the Research Governance Framework for Health and Social Care, 2nd edition, 2005
- Compliance with conditions specified by the Research Ethics Committee.
- For studies involving a Clinical Trial of an Investigational Medicinal Product, compliance with the Medicines for Human Use (Clinical Trials) Regulations (as amended)
- Compliance with all applicable legislation and regulations e.g. Data protection Act 1998, Human Tissue Act 1998.
- Agreement that you will inform us of any significant changes to the study design.
- Agreement that you will provide us with start and end dates for the study
- Agreement that you will provide us with a report on your study findings.
- Should new research members join the team post approval, you notify us so that appropriate contracts/letters of access can be issued if necessary.

- You will report any adverse, serious adverse events, SARs & SUSARS to the relevant authorities as appropriate.
- As part of the research Governance Framework, during the course of your research, that you provide information when requested for research governance monitoring and auditing purposes.
- For Clinical Trials of an Investigational Medicinal Product the Principal Investigator should have up to date ICH Good Clinical Practice Training and we would recommend the same for all members of the research team.

Please feel welcome to contact me should you require any further assistance.

I wish you every success with your study.

Yours sincerely,

Chris Cannaby

RD&I Manager

Research and Development

Royal Cornwall Hospitals NHS Trust

cc Professor Ray Jones – ray.jones@plymouth.ac.uk

Julie Cunningham

Research, Development & Innovation Department.

Appendix H. Study covering letter

Using the Internet for health care in Cornwall

We want to hear from **all adults** not just those who have used the Internet or are interested in using it

My name is Philip Abbott-Garner, I am a PhD student at Plymouth University. My research is supervised by Professors Jones and Richardson. We hope that you will be able to help with this survey being carried out in Cornwall. The survey is about using the Internet for health care, but we want to hear from **all adults** **regardless of whether you use the Internet or not**. Completing the attached questionnaire should take about 15 minutes. This letter explains why we are doing this survey and why a response from your household is important. Completing the attached questionnaire is voluntary and you are under no obligation to respond.

Why we are doing this study?

Many people find useful health information on the Internet, but some people can't access it. Not everyone wants to use it, but it is important that everyone can **if they want to**. Providing health information on the Internet could also help the NHS to save money which can then be used to fund other services. We are doing this survey to find out whether people can use the Internet for health care if they want to. We want to know what prevents people accessing the Internet and if Internet use changes over time. We also want to know how far people travel for health care and whether using the Internet has the potential to reduce health related car travel and CO² emissions.

Why should you complete it?

It will help us with our research and that will eventually lead to a better understanding of how best to use the Internet for health. As an extra incentive we will have a prize draw for the study. Winners will receive a £20 voucher of their choosing from a selection of department stores. You have a good chance (about 1 in 50) of winning.

Who should complete the questionnaire?

We would like **one adult (aged 16+)** in your household to complete and return one questionnaire in the reply paid envelope. As a way of making this a random choice, we would like the adult with the **next birthday** to complete it, regardless of whether that person has any interest in health or the Internet.

Which of the two questionnaires should be completed?

If you **have used** the Internet in the past 3 months please complete and return the **'GREEN'** questionnaire survey. If you would prefer to complete the questionnaire online a web link and unique ID can be found at the top of the questionnaire.

If you **have not personally used** the Internet in the past 3 months please complete and return the **'PINK'** questionnaire.

What will we do with your completed survey and data?

We will be analysing the data to assess the current use of the Internet for health across Cornwall. The number on the questionnaire tells us the address it came from. We are asking for your name for two purposes. Firstly, so that we can contact you should you win a prize, and secondly because we are interested in change over time we would like to contact you in around a year to ask if you have had any change of Internet use for health care.

Your right to confidentiality is very important and we will not share any of your information with anyone. Questionnaires are kept in a locked cabinet and following completion of the study all personal data will be destroyed.

You can withdraw from the study at any point without providing a reason and can do so by contacting me at the details listed on the bottom of this letter. Withdrawing from the study will in no way affect your relationship with the research team or Plymouth University.

Thank you very much for your help. If you have any questions or comments before completing the questionnaire please contact me, Philip Abbott-Garner, Faculty of Health, Education and Society, Plymouth University, 4 Portland Villas, Plymouth, PL48AA.

Telephone: 01752 586570

E-mail: philip.abbott-garner@plymouth.ac.uk

Appendix I. Pages Database



Philip Abbott-Garner
Plymouth University
Faculty of Health & Human Sciences
Room 103
4 Portland Villas
PL4 8AA
philip.abbott-garner@plymouth.ac.uk
Telephone: 01752 586570

Dear Occupant,

This booklet has been designed to make you aware of both local and national health services which may be of interest and use to you.

The enclosed information has been checked to ensure that it is both authentic and credible.

It is designed for internet and non-internet users.

If you have any enquires or comments regarding the booklet please feel free to contact me using the details listed at the top of the page.

Yours Sincerely,

Philip Abbott-Garner

PhD Student
Plymouth University

Using the Internet for Health

There are lots of good quality sites for information on the Internet including sites such as Health Talk Online, Dementia UK, British Heart Foundation, Alzheimer's Society, Mind, Stroke Association, Macmillan Cancer Support.

Most of these good quality sites are run either by the **NHS** or a **charity**.

There are of course lots of other sites offering health information from individuals, groups or commercial companies however this information may not be accurate or come from a reliable source. When it comes to your health it is best to stick to well respected sources such as those mentioned above.

NHS Choices is a good gateway to reliable and trusted health advice which has been certified by The Information Standards agency.

Don't forget that the Internet is **MORE** than just information, there are lots of discussion forums such as those that can be found on 'Patient.co.uk' where you can get advice and support from others with similar conditions.

Some people chat about their health conditions on social media including Facebook and Twitter. That's a possibility too, but you should remember that your posts may be public so you will want to consider carefully what information you choose to disclose.

There are also opportunities for you to see what other people think of local services or for you to feedback your ideas via Patient Opinion or Patient Choice.

The web addresses for the discussed websites can be found at the back of this booklet.

Reliable health information on the internet



www.nhs.uk

What is NHS Choices?

The NHS Choices website is a great way to find health information, provide feedback and hear about other people's health experiences.

There's loads of advice about medicine and symptoms. The website can also help you make other important decisions about your health.

Why is NHS Choices useful?

Being healthy is important. The NHS Choices website has easy to follow, reliable and trusted advice, bringing together expert information from across the NHS.

What's more, because it's online, this resource is at your fingertips 24/7, it's completely free and up-to-date.

Where can I find the information I need?

Browse Health A-Z	www.nhs.uk/Conditions
Check your symptoms	www.nhs.uk/SymptomCheckers
Find out more about medicine	www.nhs.uk/medicine-guides
Read common health questions	www.nhs.uk/chq
Find a service near you	www.nhs.uk/Service-Search

Reliable health information on the internet



www.nhs.uk/IPG

What is an information prescription?

Patients and carers want to know how to find information they can trust and rely on. Information prescriptions (IP) are a quick and easy way to find about your condition and local services.

Information prescriptions bring together a wealth of information sources from NHS Choices and charity partners to make it easier for you to find the information you need.

Creating an information prescription

- 1) Visit www.nhs.uk/IPG
- 2) Enter the condition you would like to know more about and your postcode (optional)
- 3) You can then select from a variety of content (including text, video, audio) from several sources.
- 4) After selecting the desired content click 'Create Information Prescription'.
- 5) Finally you can choose to email, print (as a PDF) or save the IP by clicking the corresponding button at the top of the screen.

More information can be found at

www.nhs.uk/IPG/Pages/AboutThisService.aspx

Health information on Social Media

Social media has taken the world by storm. It's much more than a way to share painfully adorable pictures of kittens, it's also a way of finding and sharing valuable information.

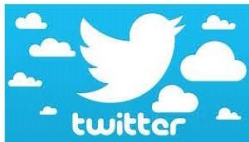
The NHS is increasingly using Social Media to engage with patients and provide up to date information.

Below is a list of the NHS presence on Social Media. Please remember that your posts may be public so you will want to consider carefully what information you choose to disclose.



www.youtube.com/NHSChoices

The service is intended to help you make choices about your health, from lifestyle decisions about things like smoking, drinking and exercise, through to the practical aspects of finding and using NHS services in England when you need them.



[@NHSChoices](https://twitter.com/NHSChoices)
twitter.com/NHSChoices

Official site of the NHS England. Everything health, including: Health A-Z, lifestyle advice, performance data & patient ratings. Monitored weekdays 9-5.30.



www.facebook.com/NHSChoices

The NHS facebook page keeps you updated on the latest health news and provides a community to help you improve your health. They post regularly about getting fit, losing weight, improving your mental wellbeing and many other popular topics.

The page aims to bring you trusted information and advice to help you lead a healthier lifestyle. It is also a place for you to share your own experiences and discuss health topics with others.

Health apps for your phone or tablet



NHS choices
health apps library

apps.nhs.uk

Safe and **trusted** apps to help you manage your health

- Reviewed by the NHS to ensure they are clinically safe and relevant to people living in England.
- Rated by you and the health care community.
- Categories include: Conditions, Healthy living, Health information & Social Care.

Some Examples



British Heart Foundation Recipe Finder

Great meal options for people with cholesterol, high blood pressure and/or diabetes.



Healthy Living App

Healthy Living application is the most comprehensive guide on healthy living, designed with all of us in mind: the young, the old, the busy on the go people. Filled with useful information on health tips, help and advice

Additional online health services

Royal Cornwall Hospitals Trust	www.rcht.nhs.uk
Macmillan Cancer Support	www.macmillan.org.uk
Mind	www.mind.org.uk
Stroke Association	www.stroke.org.uk
Alzheimer's Society	www.alzheimers.org.uk
Health Talk Online	www.healthtalkonline.org
Dementia UK	www.dementiauk.org
British Heart Foundation	www.bhf.org.uk
Patient.co.uk Discussion Forums	www.patient.co.uk/forums
Patient Opinion	www.patientopinion.org.uk
NHS Patient Choice	www.nhs.uk/comment

GPs close to your location

Your local GP's website can offer useful services to help you save time and easier manage your healthcare.

Online Repeat Prescription

This services make it more convenient for you to manage your repeat prescriptions saving you time. Prescriptions can be ordered online and collected from your local pharmacy without the added hassle of contacting your GP practice.

Online Appointment Booking

This allows you to book an appointment with your GP using their website. GP phone lines can often be busy making it difficult to get through and requiring multiple phone calls. By booking online you can reduce hassle and potentially arrange your appointment faster.

Online Access to Medical Records

This allows you to view your medical record over the internet. It allows you to easily and quickly view the electronic medical information held about you in the GP system.

Below is a list of GPs within your area and the online services that are available through their website.

	Online Repeat Prescription	Online Appointment Booking	Online Access to Medical Record
Blake House Surgery www.blakehousesurgery.co.uk Bowhay Close Black Torrington Beaworthy EX21 5QE Tel: 01409335830			
Shebbear Surgery www.shebbearsurgery.co.uk Shebbear Surgery Beech House Shebbear EX21 5RU Tel: 01409 281221			

Like to help someone to use the internet?



www.digitalskills.com

digitalskills.com aims to help make the UK the world's most digitally skilled nation.

They are scouring the web for great resources for teaching digital skills and providing a space where anyone can ask and answer questions.

Their map is starting to collect all the info about Wi-Fi hotspots, projects, organisations and more.

How you can help

Join **digitalskills.com** and spread the word.

If you know of great resources you can tell the organisation.

If you have skills to share, please add yourself or your project to the map

If there's something they can build for the site, they would like to hear

Christine's Story - Staying connected to my Grandson



Christine Moore, aged 70, had rejected technology for more than 20 years, even leaving a job when computers were brought in. However, when her grandson travelled abroad to study, she soon discovered the internet would help her keep in touch and avoiding computers was no longer an option.

"My grandson Sam was at university and as part of his degree he was going to a college in America for a year. We've always been close and the idea of not seeing him for a year was terrible. My family started talking about how they'd be able to 'Skype' him to keep in touch but I had no idea what they were talking about!

"They showed me their tablet though, and explained how they'd be able to talk to him, and SEE him and I thought it was wonderful! I went straight out and bought my own tablet so I'd be able to keep in touch with Sam myself. It was a lot of money but I knew it would be worth it to see him.

"It was actually my 10 year old granddaughter Sarah who showed me how to get onto Skype and ring Sam. It was absolutely wonderful, the picture and sound was so clear it was like he was in the room!.

"Being able to keep in touch with Sam - and Sarah when she eventually goes off to uni or traveling - means the absolute world. I always thought technology wasn't for me, even if it meant leaving a job, but now I don't know how I'd manage without it. I only wish I'd tried it years ago!"

How have others benefited?

Plymouth SeniorNet, a project helping adults aged 65+ online, asked users how they benefited from using the internet.

<p>Better communication with family, friends, or others by email or Skype, or being able to receive photos, or share things with your family or friends.</p>	<p>1st</p>
<p>Being entertained or stimulated by finding out facts, or playing games, having access to entertainment online, watching TV on 'catch up', taking part in hobbies, finding out about your family tree.</p>	<p>2nd</p>
<p>Feeling more confident because of your new skills and because you have a better idea of what is going on via the Internet and what things are happening.</p>	<p>3rd</p>
<p>Being more independent by being able to do something that otherwise someone may have had to help you with, or do for you. i.e. Internet banking, or applying for benefits online, or getting shopping delivered, or finding out about things.</p>	<p>4th</p>
<p>Saving money or having a better range of goods by shopping online or by finding out about prices and services online, for example, buying books or insurance online.</p>	<p>5th</p>
<p>Better health care because of things you have learned online, or through having better access to some online health services like online appointment booking, and prescriptions.</p>	<p>6th</p>

Free training and assistance to use the Internet



Take your first steps online with UK online

Do more online!

There are so many things you can do on the internet. It could make everyday tasks a lot easier, save you time and money and allow you to do more of the things you like doing best!

It can help you get in touch with people wherever they are in the world at the click of a button, and you can find information on whatever you're interested in, from fishing to football.

Millions of people use the internet every day as it helps make their life easier – and you could join them!

Find the help and support you need

Whether you've never touched a computer before and want to get started with the basics, or can do a little but want to know more, we're here to help you.

Our friendly tutors are on hand whatever you want to learn about – from using a mouse for the first time to finding jobs online or keeping in touch with friends and family. We'll give you a helping hand so you're confident doing whatever you want to do online.

Places that offer help to use the Internet



Your local UK Online Centre can help by providing access and training to use the Internet.

Listed below is your closest UKOC centre and your closest specialist home access centre.

Alternatively you can call: **0800 77 1234** to be directed to your nearest UK online centre for a free or low cost computer course.

Holsworthy Library

Partner Centre

At a Partner centre, you'll be able to find friendly help and support to improve your skills, as well as access to the internet

North Road,
Holsworthy
Devon
EX22 6HA
Tel: **01409 253514**
www.devon.gov.uk/libraries

Opening Times:

Monday 14:00:00 - 19:00:00
Wednesday 10:00:00 - 19:00:00
Thursday 10:00:00 - 17:00:00
Friday 14:00:00 - 17:00:00
Saturday 10:00:00 - 13:00:00

Questions & Answers CIC

Specialist Centre - Home Access

These centres can offer support and advice to help you get online access in your own home, and may have a range of internet-enabled devices for you to try out.

4 Station Road,
Redruth,
Cornwall
TR15 2AB
Tel: **01209 200583**
www.qacic.co.uk
james@qacic.co.uk

Opening Times:

Monday 09:30:00 - 14:30:00
Wednesday 09:30:00 - 14:30:00

Online learning to improve internet skills



www.learnmyway.com

What is Learn My Way?

Learn My Way is an online learning platform, built especially to make getting online easy. Learners can try the free online courses at home and work their way through with a friend or family member if they wish.

If you've got the basic online skills under your belt, this is the place to start learning a little bit more and increase your confidence in using the internet. Whether you want to learn how to shop online, access public services, complete online forms or learn how to use Facebook, there is a free online course to help you do it.

A full list of courses can be found here:

www.learnmyway.com/learn-more

"Even once you've got the basic online skills, there's still plenty in there to learn! I do all my shopping and banking online now. I'm still learning - I don't think I'll ever stop - but I'm not afraid of the computer anymore. Once you've made that first step, the world really is your oyster."



Karen, Kensington

Online learning to improve internet health skills



www.learnmyway.com/what-next/health

What is the Learn My Way Health Course?

Learn My Way is an online learning platform, built especially to make getting online easy. Learners can try the free online courses at home and work their way through with a friend or family member if they wish.

The Health course is a step by step online guide which will help you find out:

- How to use the NHS Choices website to look up conditions and illnesses
- What help is online to help you live a healthy life
- How to find and feedback on health services near you

The course is designed to help you make the most of the NHS Choices website.

“I’ve seen learners use the Health Resources on Learn my way to help them do everything from check symptoms when feeling poorly to help them stop smoking and check the rating of a hospital where they were about to have an operation! To see them getting healthier because of the help we provide getting them



Help using the Internet with a disability



Free IT support for disabled people

Reliable access to computers and the internet can change the lives of disabled people. Some people need specialist equipment but many use standard computer equipment, or new technology such as tablets and mobile phones. Some need help to choose the right equipment, others want to know more about the settings that are built into their computers.

That's why AbilityNet offers free services to people with a disability - They aim to help you get the most from computers and the internet.

Call their friendly team for any advice about computers and disability. If they don't know the answer they will know someone who does. It's a free service for disabled people and the families, friends and carers who support them.

Free helpline: 0800 269 545

www.abilitynet.org.uk

**Thank you for taking the time to look through the
booklet.**

I hope the information within has been useful to you.

**We welcome any enquires or comments regarding the
booklet, please feel free to contact me using the details
below.**

Philip Abbott-Garner
Plymouth University
Faculty of Health & Human Sciences
Room 103
4 Portland Villas
PL4 8AA
Email: philip.abbott-garner@plymouth.ac.uk
Telephone: 01752 586570

Appendix J. GP measure

***** Surgery

- 1) Patients are able to order repeat prescriptions online using The Waiting Room. **What impact has this had on the running of the surgery and the patient experience?**

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

- 2) ***** Surgery offers its patients the option to book appointments online using The Waiting Room. **What impact has this had on the running of the surgery and the patient experience?**

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

- 3) Over recent years there has been a push to enable patients to have the option to access their medical records online. This would include the ability to view test results and review recent consultations. This approach was adopted by Dr Amir Hannan at Haughton Thornley Medical Centres. Dr Hannan took over the medical centre after Harold Shipman, which had understandably left the local patients highly suspicious and mistrusting. To help alleviate these concerns, the centre provided patients with the ability to view their own medical record online using the PAERS system within its EMIS GP software. The system allows their patients to view information including test results, GP consultation notes and any correspondence between hospital consultants and GPs. The medical centre has benefited in several ways by offering patient access. Patients now have a more active role in their own healthcare and have developed a more trusting relationship with their GP. The increased access is estimated to have reduced overall appointment rates by 11% a year. There are understandable concerns for practices, including how much access a patient has to medical records and the potential for increased queries from patients.

If *** Surgery were to adopt a similar system and provide patients with online access to medical records, what impact do you think this would have on the running of the surgery and the patient experience?**

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

How feasible would it be to implement a similar system at *** Surgery?**

- Extremely difficult / Many years away
- Very difficult / over a year to implement
- Quite difficult / Many months to a year
- Could be implemented in a few months
- Could be implemented immediately
- We already offer this

Additional comments (optional):

We would like more information on this

- 4) The ***** Surgery website is quite comprehensive and offers useful information to its patients with information about long term conditions and links to NHS choices. An additional resource offered by NHS choices is the Information Prescription Service (IPS). IPS allows for the creation of a document containing information about a particular condition in a variety of content including text, audio and video. The service also includes information on local services (based on postcode) which may be helpful to a patient with a particular condition. Other resourced such as Patient.co.uk can be used in several ways to help inform patients. Patients who are computer literate can be directed to the website during a GP appointment or via a link on the surgery website. They can then visit in their own time and create a personalised information prescription containing information regarding their condition.

IPS also has a professional log in for healthcare professionals. This allows GPs to create and add their own notes to an IP for a particular patient. This can then be either posted to a patient or handed to them during a GP appointment. Prescribing patients with internet based information is based on the idea that an informed patient is better placed to make decisions about their care and well-being, and manage changes in their health status.

How feasible would it be to direct patients towards credible internet resources during a GP visit, or to provide information prescriptions to patients?

- Extremely difficult / Many years away
- Very difficult / over a year to implement
- Quite difficult / Many months to a year
- Could be implemented in a few months
- Could be implemented immediately
- We already offer this

Additional comments (optional):

What impact you do you think this would have on the running of the surgery and the patient experience?

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

We would like more information on this

- 5) St Levan Surgery in Plymouth struggled with a huge demand for GP appointments and often had a very crowded waiting room. Same day appointments were regularly completely booked by 8:30am meaning patients were waiting over a day to talk to a GP. In 2008 the surgery adopted a phone triage system in an attempt to solve these issues. Patients contacting the surgery now initially have a phone consultation with a GP and can receive same

day face-to-face appointments if needed. The surgery reports many positive benefits from using the system. All patients are now able to speak to a doctor on the day that they ring, 50% of patients are managed without the need for a face-to-face appointment, shorter waiting times, less need to wait with other ill patients, doctors and staff are less stressed and there is greater flexibility in appointment length to deal with complex problems.

There is debate over the effect which phone triage has on a practice's workload. Phone triage can reduce face-to-face visitations but also increases the number of phone consultations per GP, it therefore can redistribute a GPs current workload.

How feasible would it be to implement a similar phone triage system at ***
Surgery?**

- Extremely difficult / Many years away
- Very difficult / over a year to implement
- Quite difficult / Many months to a year
- Could be implemented in a few months
- Could be implemented immediately
- We already offer this

Additional comments (optional):

What impact you do you think this would have on the running of the surgery and the patient experience?

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

We would like more information on this

- 6) With the installation of high speed internet by the Superfast Cornwall project and a general increase in internet speeds there is the potential to, at some point in future, offer live video consultations to patients over the internet. Currently the use of skype or a similar video conference software has been trialed in

small pilot studies in areas such as dermatology. The use of video consultations could be effective in 'hard to reach' or rural settings and potentially reduce patient car travel while still offering a 'face-to-face' consultation.

How feasible would it be to offer video consultations over the internet at ***
Surgery?**

- Extremely difficult / Many years away
- Very difficult / over a year to implement
- Quite difficult / Many months to a year
- Could be implemented in a few months
- Could be implemented immediately
- We already offer this

Additional comments (optional):

What impact you do you think this would have on the running of the surgery and the patient experience?

- Large detriment
- Small detriment
- No benefit
- Small benefit
- Large benefit
- Don't Know

Additional comments (optional):

We would like more information on this

REFERENCES

1. M Khalil M, Jones R. Electronic Health Services An Introduction to Theory and Application. 2007 2007;**2**(4)
2. Oh H, Rizo C, Enkin M, et al. What Is eHealth (3): A Systematic Review of Published Definitions. *J Med Internet Res* 2005;**7**(1):e1
3. Eysenbach G. What is e-health? *J Med Internet Res* 2001;**3**(2):e20
4. Jones RB, O'Connor A, Brelsford J, et al. Costs and difficulties of recruiting patients to provide e-health support: pilot study in one primary care trust. *BMC Medical Informatics and Decision Making* 2012;**12**(1):25
5. Dutton WH, Blank G, Groselj D. Cultures of the Internet: The Internet in Britain. Oxford Internet Survey 2013 Oxford Internet Institute 2013
6. Dutton W, Blank G. Oxford Internet Survey 2011. Next Generation Users: The Internet in Britain. University of Oxford: Oxford Internet Institute, 2011.
7. Van Dijk JA. Digital divide research, achievements and shortcomings. *Poetics* 2006;**34**(4):221-35
8. Health Do. Digital First - The delivery choice for England's population. 2012
9. Office for National Statistics. 2011 Census: Aggregate data (England and Wales) 2011. Downloaded from: <http://infuse.mimas.ac.uk>. This information is licensed under the terms of the Open Government Licence [<http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2>].
10. Director of Public Health. Cornwall and Isles of Scilly Strategy to Reduce Health Inequalities Good Health and Well Being for Everyone 2011 – 2016. 2011. <https://www.cornwall.gov.uk/media/3640163/Good-Health-for-Everyone-HI-Final.pdf>.
11. <http://www.superfastcornwall.org/>. 2013. <http://www.superfastcornwall.org/>.
12. BDUK. Broadband Delivery Programme: Delivery Model. Department for culture, media and sport, 2011.
13. Ekeland AG, Bowes A, Flottorp S. Effectiveness of telemedicine: a systematic review of reviews. *International Journal of Medical Informatics* 2010;**79**(11):736-71
14. Barak A, Hen L, Boniel-Nissim M, et al. A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. *Journal of Technology in Human Services* 2008;**26**(2-4):109-60
15. Myung SK, McDonnell DD, Kazinets G, et al. Effects of Web- and computer-based smoking cessation programs: Meta-analysis of randomized controlled trials. *Archives of Internal Medicine* 2009;**169** (10):929-37
16. Reger MA, Gahm GA. A meta-analysis of the effects of internet- and computer-based cognitive-behavioral treatments for anxiety. *Journal of Clinical Psychology* 2009;**65**(1):53-75
17. Spek V, Cuijpers P, Nyklicek I, et al. Internet-based cognitive behaviour therapy for symptoms of depression and anxiety: a meta-analysis. *Psychol Med* 2007;**37**(3):319-28 doi: 10.1017/s0033291706008944[published Online First: Epub Date]].
18. van den Berg MH, Schoones JW, Vliet Vlieland TP. Internet-Based Physical Activity Interventions: A Systematic Review of the Literature. *J Med*

- Internet Res 2007;**9**(3):e26 doi: 10.2196/jmir.9.3.e26[published Online First: Epub Date]].
19. Jaana M, Pare G. Home telemonitoring of patients with diabetes: a systematic assessment of observed effects. *J Eval Clin Pract* 2007;**13**(2):242-53 doi: 10.1111/j.1365-2753.2006.00686.x[published Online First: Epub Date]].
 20. Martinez A, Everss E, Rojo-Alvarez JL, et al. A systematic review of the literature on home monitoring for patients with heart failure. *J Telemed Telecare* 2006;**12**(5):234-41 doi: 10.1258/135763306777889109[published Online First: Epub Date]].
 21. Cuijpers P, van Straten A, Andersson G. Internet-administered cognitive behavior therapy for health problems: a systematic review. *Journal of Behavioral Medicine* 2008;**31**(2):169-77 doi: 10.1007/s10865-007-9144-1[published Online First: Epub Date]].
 22. Griffiths KM, Christensen H. Review of randomised controlled trials of Internet interventions for mental disorders and related conditions. *Clinical Psychologist* 2006;**10**(1):16-29 doi: 10.1080/13284200500378696[published Online First: Epub Date]].
 23. Jackson CL, Bolen S, Brancati FL, et al. A systematic review of interactive computer-assisted technology in diabetes care. *Interactive information technology in diabetes care. J Gen Intern Med* 2006;**21**(2):105-10 doi: 10.1111/j.1525-1497.2005.00310.x[published Online First: Epub Date]].
 24. Azar M, Gabbay R. Web-based management of diabetes through glucose uploads: has the time come for telemedicine? *Diabetes Res Clin Pract* 2009;**83**(1):9-17 doi: 10.1016/j.diabres.2008.09.055[published Online First: Epub Date]].
 25. Weinstein PK. A review of weight loss programs delivered via the Internet. *J Cardiovasc Nurs* 2006;**21**(4):251-8; quiz 59-60
 26. Linton SJ. Datorbaserad kognitiv beteendeterapi vid ångestsyndrom eller depression. 2007
 27. Linn AJ, Vervloet M, van Dijk L, et al. Effects of eHealth interventions on medication adherence: a systematic review of the literature. *Journal of medical Internet research* 2011;**13**(4):e103-e03
 28. Civljak M, Stead Lindsay F, Hartmann-Boyce J, et al. Internet-based interventions for smoking cessation. *Cochrane Database of Systematic Reviews* 2013; (7).
<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD007078.pub4/abstract>.
 29. Bailey Julia V, Murray E, Rait G, et al. Interactive computer-based interventions for sexual health promotion. *Cochrane Database of Systematic Reviews* 2010; (9).
<http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD006483.pub2/abstract>
<http://onlinelibrary.wiley.com/store/10.1002/14651858.CD006483.pub2/asset/CD006483.pdf?v=1&t=hrme0w20&s=e4f8e87cf012c99f6fa02225cfc95f3a362c69eb>.
 30. Cha YJ, Kim H. Effect of computer-based cognitive rehabilitation (CBCR) for people with stroke: A systematic review and meta-analysis. *NeuroRehabilitation* 2013;**32** (2):359-68
 31. Kok PE-d, van Os-Medendorp H, Vergouwe-Meijer A, et al. A systematic review of the effects of e-health on chronically ill patients. *Journal of*

- Clinical Nursing 2011;**20**(21-22):2997-3010 doi: 10.1111/j.1365-2702.2011.03743.x[published Online First: Epub Date]].
32. Elbert NJ, van Os-Medendorp H, van Renselaar W, et al. Effectiveness and Cost-Effectiveness of eHealth Interventions in Somatic Diseases: A Systematic Review of Systematic Reviews and Meta-Analyses. *J Med Internet Res* 2014;**16**(4):e110 doi: 10.2196/jmir.2790[published Online First: Epub Date]].
 33. Krukowski RA, Tilford JM, Harvey-Berino J, et al. Comparing behavioral weight loss modalities: incremental cost-effectiveness of an internet-based versus an in-person condition. *Obesity* 2011;**19**(8):1629-35
 34. Sjostrom M, Umefjord G, Lindholm L, et al. Cost-effectiveness of an Internet-based treatment program for stress urinary incontinence. *Neurourol Urodyn* 2013 doi: 10.1002/nau.22540[published Online First: Epub Date]].
 35. Meer V, Hout WB, Bakker MJ, et al. Cost-effectiveness of Internet-based self-management compared with usual care in asthma. *PloS one* 2011; (11). <http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/567/CN-00860567/frame.html>.
 36. Ljotsson B, Andersson G, Andersson E, et al. Acceptability, effectiveness, and cost-effectiveness of internet-based exposure treatment for irritable bowel syndrome in a clinical sample: a randomized controlled trial. *BMC gastroenterology* 2011;**11**:110
 37. Warmerdam L, Smit F, van Straten A, et al. Cost-utility and cost-effectiveness of internet-based treatment for adults with depressive symptoms: randomized trial. *Journal of medical Internet research* 2010;**12**(5):e53
 38. Os-Medendorp H, Koffijberg H, Eland-De Kok PCM, et al. E-health in caring for patients with atopic dermatitis: A randomized controlled cost-effectiveness study of internet-guided monitoring and online self-management training. *British Journal of Dermatology* 2012; (5). <http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/280/CN-00841280/frame.html>.
 39. Smith AC, Patterson V, Scott RE. Reducing your carbon footprint: how telemedicine helps. *BMJ: British Medical Journal* 2007;**335**(7629):1060
 40. Smith AC, Kimble RM, O'Brien A, et al. A telepaediatric burns service and the potential travel savings for families living in regional Australia. *Journal of Telemedicine and Telecare* 2007;**13**(suppl 3):76-79
 41. Patterson V. Teleneurology. *Journal of Telemedicine and Telecare* 2005;**11**(2):55-59
 42. Holmner Å, Rocklöv J, Ng N, et al. Climate change and eHealth: a promising strategy for health sector mitigation and adaptation. *Global health action* 2012;**5**
 43. Yellowlees PM, Chorba K, Burke Parish M, et al. Telemedicine can make healthcare greener. *Telemedicine and e-Health* 2010;**16**(2):229-32
 44. Masino C, Rubinstein E, Lem L, et al. The impact of telemedicine on greenhouse gas emissions at an academic health science center in Canada. *Telemedicine and e-Health* 2010;**16**(9):973-76
 45. Reducing environmental impact: an example of how e-health can reduce environmental impact and concomitantly improve health. *Proceedings of The 1st Annual Conference on e-Health: The Virtual Dimensions of Health and Environment* Empower, Enhance, Enforce; 2009.*

46. Jones RB, Goldsmith L. What is the evidence for the benefits and outcomes for digital health services? Final Report to NHS Choices University of Plymouth 2009
47. Williams TL, May CR, Esmail A. Limitations of patient satisfaction studies in telehealthcare: a systematic review of the literature. *Telemedicine Journal and e-Health* 2001;**7**(4):293-316
48. Whitten P, Love B. Patient and provider satisfaction with the use of telemedicine: overview and rationale for cautious enthusiasm. *Journal of postgraduate medicine* 2005;**51**(4):294
49. Mair F, Whitten P, May C, et al. Patients' perceptions of a telemedicine specialty clinic. *Journal of Telemedicine and Telecare* 2000;**6**(1):36-40
50. Statistics TOoN. Internet Access – Households and Individuals. 2015.
<http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/guide-method/method-quality/specific/business-and-energy/e-commerce-and-ict-activity/barriers-to-internet-access/index.html>.
51. Age U. Digital inclusion evidence review: London: Age UK, 2013.
52. Wagner TH, Bundorf MK, Singer SJ, et al. Free internet access, the digital divide, and health information. *Medical Care* 2005;**43**(4):415-20
53. Levy H, Janke AT, Langa KM. Health literacy and the digital divide among older americans. *Journal of general internal medicine* 2015;**30**(3):284-9 doi: 10.1007/s11606-014-3069-5[published Online First: Epub Date]].
54. Van Dijk J. The evolution of the digital divide: The digital divide turns to inequality of skills and usage. J Bus, M Crompton, M Hildebrandt, & G Metakides (Eds), *Digital enlightenment yearbook 2012*;2012:57-75
55. Hargittai E. *Second-Level Digital Divide: Differences in People's Online Skills*, 2002.
56. Pearce KE, Rice RE. Digital divides from access to activities: Comparing mobile and personal computer Internet users. *Journal of Communication* 2013;**63**(4):721-44 doi: 10.1177/2050157912459182.
<http://dx.doi.org/10.1111/jcom.12045>[published Online First: Epub Date]].
57. Sundquist M, Markendahl J. A case study cost modelling of regulatory alternatives to mitigate the mobile network coverage and capacity problems in rural areas. 2015
58. Gatto SL, Tak SH. Computer, Internet, and E-mail Use Among Older Adults: Benefits and Barriers. *Educational Gerontology* 2008;**34**(9):800-11 doi: 10.1080/03601270802243697[published Online First: Epub Date]].
59. Xie B. Older adults, computers, and the Internet: Future directions. *Gerontechnology* 2003;**2**(4):289-305
60. Dart J. The internet as a source of health information in three disparate communities. *Australian Health Review* 2008;**32**(3):559-69
61. Helft PR, Eckles RE, Johnson-Calley CS, et al. Use of the internet to obtain cancer information among cancer patients at an urban county hospital. *Journal of Clinical Oncology* 2005;**23**(22):4954-62
62. Blackburn C, Read J. Using the Internet? The experiences of parents of disabled children. *Child: care, health and development* 2005;**31**(5):507-15
63. Farrington J, Philip L, Cottrill C, et al. Two-Speed Britain: Rural Internet Use. Available at SSRN 2645771 2015

64. Rains SA. Health at high speed: Broadband internet access, health communication, and the digital divide. *Communication Research* 2008;**35**(3):283-97 doi: <http://dx.doi.org/10.1177/0093650208315958>[published Online First: Epub Date]].
65. Lemaire ED, Boudrias Y, Greene G. Low-bandwidth, Internet-based videoconferencing for physical rehabilitation consultations. *Journal of Telemedicine and Telecare* 2001;**7**(2):82-89
66. Skinner H, Biscope S, Poland B. Quality of internet access: Barrier behind internet use statistics. *Social Science & Medicine* 2003;**57**(5):875-80 doi: [http://dx.doi.org/10.1016/S0277-9536\(02\)00455-0](http://dx.doi.org/10.1016/S0277-9536(02)00455-0)[published Online First: Epub Date]].
67. Skinner H, Biscope S, Poland B, et al. How adolescents use technology for health information: implications for health professionals from focus group studies. *Journal of medical internet research* 2003;**5**(4)
68. Delivering group-based services to the home via the internet: Maximising clinical and social benefits. *Pervasive Computing Technologies for Healthcare (PervasiveHealth)*, 2011 5th International Conference on; 2011. IEEE.
69. Demaerschalk BM, Vegunta S, Vargas BB, et al. Reliability of real-time video smartphone for assessing National Institutes of Health Stroke Scale scores in acute stroke patients. *Stroke* 2012;**43**(12):3271-77
70. Jones R. Development of a Questionnaire and Cross-Sectional Survey of Patient eHealth Readiness and eHealth Inequalities. *Med 2 0* 2013;**2**(2):e9 doi: 10.2196/med20.2559[published Online First: Epub Date]].
71. Jones R, Goldsmith L, O'Connor A. Inequalities in general practice website provision. *The British Journal of General Practice* 2011;**61**(592):663-63 doi: 10.3399/bjgp11X606555[published Online First: Epub Date]].
72. RIXG. Which Units have Renal Patient View. 2011. <http://www.renal.org/whatwedo/JointActivitiesSection/RIXGSection/RenalPatientView/RIXGWhere.aspx>.
73. Alkhalidi B, Sahama T, Huxley C, et al. Barriers to implementing eHealth: a multi-dimensional perspective. *Stud Health Technol Inform* 2014;**205**:875-9
74. Anderson JG. Social, ethical and legal barriers to e-health. *International journal of medical informatics* 2007;**76**(5):480-83
75. Mair FS, May C, O'Donnell C, et al. Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review. *Bulletin of the World Health Organization* 2012;**90**(5):357-64
76. Kruse RL, Koopman RJ, Wakefield BJ, et al. Internet use by primary care patients: where is the digital divide? *Family medicine* 2012;**44**(5):342-47
77. Bowen D, Meischke H, Bush N, et al. Predictors of women's Internet access and Internet health seeking. *Health care for women international* 2003;**24**(10):940-51
78. Lenhart A, Horrigan J, Allen K, et al. The ever-shifting Internet population: a new look at Internet access and the digital divide. Washington, DC: Pew Charitable Trusts, 2003.
79. Mancini J, Noguès C, Adenis C, et al. Patients' characteristics and rate of Internet use to obtain cancer information. *Journal of public health* 2006;**28**(3):235-37

80. Greenhalgh T, Wood GW, Bratan T, et al. Patients' attitudes to the summary care record and HealthSpace: qualitative study. *BMJ* 2008;**336**(7656):1290-95
81. Khechine H, Pascot D, Prémont P. Use of health-related information from the Internet by English-speaking patients. *Health Informatics Journal* 2008;**14**(1):17-28
82. Williams P, Nicholas D, Huntington P. Non use of health information kiosks examined in an information needs context. *Health Information & Libraries Journal* 2003;**20**(2):95-103
83. Flynn KE, Smith MA, Freese J. When do older adults turn to the internet for health information? Findings from the Wisconsin Longitudinal Study. *Journal of General Internal Medicine* 2006;**21**(12):1295-301
84. Rice R. Influences, usage, and outcomes of Internet health information searching: Multivariate results from the Pew surveys. *International Journal of Medical Informatics* 2006;**75**(1):8-28
85. Houston TK, Allison JJ. Users of Internet health information: differences by health status. *Journal of medical Internet research* 2002;**4**(2):e7
86. Renahy E, Parizot I, Chauvin P. Health information seeking on the Internet: a double divide? Results from a representative survey in the Paris metropolitan area, France, 2005-2006. *BMC Public Health* 2008;**8**:10 doi: 10.1186/1471-2458-8-69[published Online First: Epub Date].
87. Zajicek M, Hall S. Solutions for elderly visually impaired people using the Internet. *People and Computers XIV—Usability or Else!*: Springer, 2000:299-307.
88. Stronge AJ, Walker N, Rogers WA. Searching the World Wide Web: Can older adults get what they need. *Human factors interventions for the health care of older adults* 2001:255-69
89. Ownby RL, Czaja SJ, Lee CC. Older adults, information technology, and behavioral health care. *Behavioral Healthcare Informatics*: Springer, 2002:77-86.
90. Birru MS, Monaco VM, Charles L, et al. Internet Usage by Low-Literacy Adults Seeking Health Information: An Observational Analysis. *J Med Internet Res* 2004;**6**(3):e25 doi: 10.2196/jmir.6.3.e25[published Online First: Epub Date].
91. Chan CV. A micro-analytic method for characterizing eHealth literacy demands and barriers of consumer health tasks, 2011.
92. Kontos E, Blake KD. Predictors of eHealth usage: insights on the digital divide from the Health Information National Trends Survey 2012. 2014;**16**(7):e172 doi: 10.2196/jmir.3117[published Online First: Epub Date].
93. Blank G. Proxy users in the UK: An overview. 2013. <http://oxis.oii.ox.ac.uk/blog/proxy-users-uk-overview/>.
94. Adams N, Stubbs D, Woods V. Psychological barriers to Internet usage among older adults in the UK. *Med Inform Internet Med* 2005;**30**(1):3-17 doi: 10.1080/14639230500066876[published Online First: Epub Date].
95. Choi NG, DiNitto DM. The Digital Divide Among Low-Income Homebound Older Adults: Internet Use Patterns, eHealth Literacy, and Attitudes Toward Computer/Internet Use. *J Med Internet Res* 2013;**15**(5):e93 doi: 10.2196/jmir.2645[published Online First: Epub Date].

96. Trocchia PJ, Janda S. A phenomenological investigation of Internet usage among older individuals. *Journal of consumer marketing* 2000;**17**(7):605-16
97. Hardiker NR, Grant MJ. Barriers and facilitators that affect public engagement with eHealth services. *Stud Health Technol Inform* 2010;**160**(Pt 1):13-7
98. Sheaves B, Jones RB, Williamson GR, et al. Phase 1 pilot study of e-mail support for people with long term conditions using the Internet. *BMC Medical Informatics and Decision Making* 2011;**11**:20
99. UKOC. UKOC Find a Centre. 2015. <https://www.ukonlinecentres.com/about-us/centre-search#/>.
100. Stellefson M, Chaney B, Chaney D. The digital divide in health education: myth or reality? *American Journal of Health Education* 2008;**39**(2):106-12
101. National Telecommunications and Information Administration. Digital Nation: Expanding Internet Usage (NTIA Research Preview) 2009. http://www.ntia.doc.gov/reports/2011/NTIA_Internet_Use_Report_February_2011.pdf.
102. Fogel J, Albert SM, Schnabel F, et al. Use of the Internet by women with breast cancer. *Journal of Medical Internet Research* 2002;**4**(2):e9
103. Peterson MW, Fretz PC. Patient use of the internet for information in a lung cancer clinic*. *Chest* 2003;**123**(2):452-57 doi: 10.1378/chest.123.2.452[published Online First: Epub Date]].
104. Health literacy: report of the Council on Scientific Affairs. Ad Hoc Committee on Health Literacy for the Council on Scientific Affairs, American Medical Association. *Jama* 1999;**281**(6):552-7
105. Jensen JD, King AJ, Davis LA, et al. Utilization of internet technology by low-income adults the role of health literacy, health numeracy, and computer assistance. *Journal of aging and health* 2010;**22**(6):804-26
106. Frenn M, Malin S, Brown RL, et al. Changing the tide: an Internet/video exercise and low-fat diet intervention with middle-school students. *Applied Nursing Research* 2005;**18**(1):13-21 doi: <http://dx.doi.org/10.1016/j.apnr.2004.04.003>[published Online First: Epub Date]].
107. Chong J, Moreno F. Feasibility and acceptability of clinic-based telepsychiatry for low-income Hispanic primary care patients. *Telemedicine and e-Health* 2012;**18**(4):297-304
108. Wise M, Pulvermacher A, Shanovich KK, et al. Using action research to implement an integrated pediatric asthma case management and eHealth intervention for low-income families. *Health promotion practice* 2010;**11**(6):798-806
109. Gustafson DH, McTavish FM, Stengle W, et al. Use and impact of eHealth system by low-income women with breast cancer. *Journal of Health Communication* 2005;**10**(S1):195-218
110. Eyrych-Garg KM. Sheltered in cyberspace? Computer use among the unsheltered 'street' homeless. *Comput Hum Behav* 2011;**27**(1):296-303 doi: 10.1016/j.chb.2010.08.007[published Online First: Epub Date]].
111. Broos A, Roe K. The digital divide in the playstation generation: Self-efficacy, locus of control and ICT adoption among adolescents. *Poetics* 2006;**34**(4):306-17
112. Bukachi F, Pakenham-Walsh N. Information technology for health in developing countries. *CHEST Journal* 2007;**132**(5):1624-30

113. Legare E, Vincent C, Lehoux P, et al. Telehealth readiness assessment tools. *Journal of Telemedicine and Telecare* 2010;**16**(3):107-09
114. Snyder-Halpern R. Indicators of organizational readiness for clinical information technology/systems innovation: a Delphi study. *International journal of medical informatics* 2001;**63**(3):179-204
115. Lehman WE, Greener JM, Simpson DD. Assessing organizational readiness for change. *Journal of substance abuse treatment* 2002;**22**(4):197-209
116. Oliver DRP, Demiris G. An assessment of the readiness of hospice organizations to accept technological innovation. *Journal of Telemedicine and telecare* 2004;**10**(3):170-74
117. Assessing home care agencies' readiness for telehealth. AMIA Annual Symposium Proceedings; 2003. American Medical Informatics Association.
118. Khoja S, Scott RE, Casebeer AL, et al. e-Health readiness assessment tools for healthcare institutions in developing countries. *Telemedicine and e-Health* 2007;**13**(4):425-32
119. Jennett P, Jackson A, Ho K, et al. The essence of telehealth readiness in rural communities: an organizational perspective. *Telemedicine Journal & e-Health* 2005;**11**(2):137-45
120. Légaré É, Vincent C, Lehoux P, et al. Developing and validating the French-Canadian version of the practitioner and organizational telehealth readiness assessment tools. *Journal of telemedicine and telecare* 2010;**16**(3):140-46
121. Statistics OfN. Internet Access Quarterly Update, Q1 2013, 2013.
122. Norman CD, Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res* 2006;**8**(4):e27 doi: 10.2196/jmir.8.4.e27[published Online First: Epub Date].
123. Norman CD, Skinner HA. eHealth literacy: essential skills for consumer health in a networked world. *Journal of medical Internet research* 2006;**8**(2)
124. van der Vaart R, van Deursen AJAM, Drossaert CHC, et al. Does the eHealth Literacy Scale (eHEALS) measure what it intends to measure? Validation of a Dutch version of the eHEALS in two adult populations. *Journal of Medical Internet Research* 2011;**13**(4):428-38 doi: 10.1007/BF02310555].1952-03137-00110.1007/BF02310555
<http://dx.doi.org/10.2196/jmir.1840>[published Online First: Epub Date].
125. Rogers EM. *Diffusion of innovations*: Simon and Schuster, 2010.
126. Zhang X, Yu P, Yan J, et al. Using diffusion of innovation theory to understand the factors impacting patient acceptance and use of consumer e-health innovations: a case study in a primary care clinic. *BMC health services research* 2015;**15**(1):1
127. Sahin I. Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *TOJET: The Turkish Online Journal of Educational Technology* 2006;**5**(2)
128. <http://www.ukonlinecentres.com/about-us/background.html>. 2013.
<http://www.ukonlinecentres.com/about-us/background.html>.
129. UKOC. <http://www.ukonlinecentres.com/>. 2013.
<http://www.ukonlinecentres.com/>.
130. Ipsos. Digital inclusion, social impact:a research study: UKOC, 2008.
131. <http://www.go-on.co.uk/about-us/our-mission>. 2013. <http://www.go-on.co.uk/about-us/our-mission>.

132. <http://www.ageuk.org.uk/about-us/>. 2013. <http://www.ageuk.org.uk/about-us/>.
133. UK GO. [http://www.gov.uk/files/5113/6822/1206/Go On Presentation Inside Government - Digital Inclusion.ppt](http://www.gov.uk/files/5113/6822/1206/Go_On_Presentation_Inside_Government_-_Digital_Inclusion.ppt). Accessed 2013.
134. Car J, Lang B, Colledge A, et al. Interventions for enhancing consumers' online health literacy. The Cochrane Library 2011
135. Lee K, Hoti K, Hughes JD, et al. Interventions to Assist Health Consumers to Find Reliable Online Health Information: A Comprehensive Review. PLoS ONE 2014;**9**(4):e94186 doi: 10.1371/journal.pone.0094186[published Online First: Epub Date]].
136. Watkins I, Xie B. eHealth Literacy Interventions for Older Adults: A Systematic Review of the Literature. J Med Internet Res 2014;**16**(11):e225 doi: 10.2196/jmir.3318[published Online First: Epub Date]].
137. Neafsey PJ, Anderson E, Peabody S, et al. Beta testing of a network-based health literacy program tailored for older adults with hypertension. Computers, informatics, nursing: CIN 2008;**26**(6):311
138. Ownby RL, Hertzog C, Czaja SJ. Tailored information and automated reminding to improve medication adherence in Spanish-and English-speaking elders treated for memory impairment. Clinical gerontologist 2012;**35**(3):221-38
139. Noureldin M, Plake KS, Morrow DG, et al. Effect of Health Literacy on Drug Adherence in Patients with Heart Failure. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy 2012;**32**(9):819-26 doi: 10.1002/j.1875-9114.2012.01109.x[published Online First: Epub Date]].
140. Bosworth HB, Olsen MK, Grubber JM, et al. Two self-management interventions to improve hypertension control: a randomized trial. Annals of internal medicine 2009;**151**(10):687-95
141. Krebs P, Prochaska JO, Rossi JS. A meta-analysis of computer-tailored interventions for health behavior change. Preventive medicine 2010;**51**(3):214-21
142. Radhakrishnan K. The efficacy of tailored interventions for self-management outcomes of type 2 diabetes, hypertension or heart disease: a systematic review. J Adv Nurs 2012;**68**(3):496-510 doi: 10.1111/j.1365-2648.2011.05860.x[published Online First: Epub Date]].
143. Sweeney GM, Donovan CL, March S, et al. Can we improve parent attitudes and intentions to access computer-based therapies for their children and adolescents? Child and Adolescent Mental Health 2016:n/a-n/a doi: 10.1111/camh.12180[published Online First: Epub Date]].
144. Ebert DD, Berking M, Cuijpers P, et al. Increasing the acceptance of internet-based mental health interventions in primary care patients with depressive symptoms. A randomized controlled trial. J Affect Disord 2015;**176**:9-17 doi: 10.1016/j.jad.2015.01.056[published Online First: Epub Date]].
145. Donovan CL, Poole C, Boyes N, et al. Australian mental health worker attitudes towards cCBT: What is the role of knowledge? Are there differences? Can we change them? Internet Interventions 2015;**2**(4):372-81 doi: 10.1016/j.invent.2015.09.001[published Online First: Epub Date]].
146. Baumeister H, Nowoczin L, Lin J, et al. Impact of an acceptance facilitating intervention on diabetes patients' acceptance of Internet-based interventions for depression: a randomized controlled trial. Diabetes Res

- Clin Pract 2014;**105**(1):30-9 doi:
10.1016/j.diabres.2014.04.031[published Online First: Epub Date]].
147. Casey LM, Joy A, Clough BA. The impact of information on attitudes toward e-mental health services. *Cyberpsychology, Behavior, and Social Networking* 2013;**16**(8):593-98
 148. Mitchell N, Gordon PK. Attitudes Towards Computerized CBT for Depression Amongst a Student Population. *Behavioural and Cognitive Psychotherapy* 2007;**35**(4):421-30 doi:
10.1017/S1352465807003700[published Online First: Epub Date]].
 149. Xie B. Effects of an eHealth Literacy Intervention for Older Adults. *J Med Internet Res* 2011;**13**(4):e90 doi: 10.2196/jmir.1880[published Online First: Epub Date]].
 150. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC health services research* 2010;**10**(1):1
 151. McGinn CA, Grenier S, Duplantie J, et al. Comparison of user groups' perspectives of barriers and facilitators to implementing electronic health records: a systematic review. *BMC medicine* 2011;**9**(1):1
 152. Jha AK, Bates DW, Jenter C, et al. Electronic health records: use, barriers and satisfaction among physicians who care for black and Hispanic patients. *Journal of evaluation in clinical practice* 2009;**15**(1):158-63
 153. Ludwick D, Doucette J. Primary care physicians' experience with electronic medical records: barriers to implementation in a fee-for-service environment. *International Journal of Telemedicine and Applications* 2009;**2009**:2
 154. Li J, Talaei-Khoei A, Seale H, et al. Health care provider adoption of eHealth: systematic literature review. *Interactive journal of medical research* 2013;**2**(1):e7
 155. Morton ME. Use and acceptance of an electronic health record: factors affecting physician attitudes. Drexel University, 2008.
 156. Shiffman RN, Michel G, Essaihi A, et al. Bridging the guideline implementation gap: a systematic, document-centered approach to guideline implementation. *Journal of the American Medical Informatics Association* 2004;**11**(5):418-26
 157. Thorn SA, Carter MA, Bailey JE. Emergency physicians' perspectives on their use of health information exchange. *Annals of emergency medicine* 2014;**63**(3):329-37
 158. Putzer GJ. Are physicians likely to adopt emerging mobile technologies? Attitudes and innovation factors affecting smartphone use in the Southeastern United States. *Perspectives in Health Information Management* 2012:1
 159. de Grood C, Raissi A, Kwon Y, et al. Adoption of e-health technology by physicians: a scoping review. *Journal of Multidisciplinary Healthcare* 2016;**9**:335
 160. Rogove HJ, McArthur D, Demaerschalk BM, et al. Barriers to telemedicine: survey of current users in acute care units. *Telemedicine and e-Health* 2012;**18**(1):48-53
 161. Dünnebeil S, Sunyaev A, Blohm I, et al. Determinants of physicians' technology acceptance for e-health in ambulatory care. *International journal of medical informatics* 2012;**81**(11):746-60

162. Bramble JD, Galt KA, Siracuse MV, et al. The relationship between physician practice characteristics and physician adoption of electronic health records. *Health care management review* 2010;**35**(1):55-64
163. Rubin HJ, Rubin IS. *Qualitative interviewing: The art of hearing data*: Sage, 2011.
164. Wand Y, Weber R. On the ontological expressiveness of information systems analysis and design grammars. *Information Systems Journal* 1993;**3**(4):217-37 doi: 10.1111/j.1365-2575.1993.tb00127.x[published Online First: Epub Date]].
165. Carson D, Gilmore A, Perry C, et al. *Qualitative marketing research*: Sage, 2001.
166. Maxwell JA. *A realist approach for qualitative research*: Sage, 2012.
167. Merrill RM. *Introduction to epidemiology*: Jones & Bartlett Publishers, 2013.
168. Mack L. The philosophical underpinnings of educational research. *Polyglossia* 2010;**19**:5-11
169. Neuman WL. *Social research methods: Quantitative and qualitative approaches*: Allyn and Bacon Boston, 2005.
170. Broom A, Willis E. Competing paradigms and health research. *Researching health: qualitative, quantitative and mixed methods* 2007:16-30
171. Song JW, Chung KC. Observational studies: cohort and case-control studies. *Plastic and reconstructive surgery* 2010;**126**(6):2234
172. Sibbald B, Roland M. *Understanding controlled trials: Why are randomised controlled trials important?*, 1998.
173. Petticrew M, Cummins S, Ferrell C, et al. Natural experiments: an underused tool for public health? *Public health* 2005;**119**(9):751-57
174. Grimshaw J, Campbell M, Eccles M, et al. Experimental and quasi-experimental designs for evaluating guideline implementation strategies. *Family practice* 2000;**17**(90001):11-16
175. Shadish WR, Cook TD, Campbell DT. *Experimental and quasi-experimental designs for generalized causal inference*: Wadsworth Cengage learning, 2002.
176. White H, Sabarwal S. Quasi-experimental design and methods. *Methodological Briefs: Impact Evaluation* 2014;**8**
177. Pandis N, Walsh T, Polychronopoulou A, et al. Factorial designs: an overview with applications to orthodontic clinical trials. *The European Journal of Orthodontics* 2013:cjt054
178. Edwards SJ, Braunholtz DA, Lilford RJ, et al. Ethical issues in the design and conduct of cluster randomised controlled trials. *BMJ: British Medical Journal* 1999;**318**(7195):1407
179. Pfefferman D, Rao CR. *Sample Surveys*: Elsevier, 2009.
180. Killip S, Mahfoud Z, Pearce K. What is an intracluster correlation coefficient? Crucial concepts for primary care researchers. *The Annals of Family Medicine* 2004;**2**(3):204-08
181. Zoopla. <http://www.zoopla.co.uk/>. 2012. <http://www.zoopla.co.uk/>.
182. The NHS Information Centre. National Kidney Care Audit Patient Transport Survey, 2011.
183. SurveyMonkey. 2012. <https://www.surveymonkey.co.uk/>.
184. UK Online Centres. Marketing Toolkit. 2015. <http://www.ukonlinecentres.com/running-your-centre/promote-your-centre/marketing-toolkit>.

185. Tinder & UKOC. Learn My Way Online Platform. 2014.
<http://www.learnmyway.com/>.
186. NHS Choices. NHS Choices Homepage. 2014.
<http://www.nhs.uk/Pages/HomePage.aspx>.
187. NHS Choices. About Us. 2014.
<http://www.nhs.uk/aboutNHSChoices/aboutnhschoices/Aboutus/Pages/Introduction.aspx>.
188. NICE. NHS Evidence. 2014. <https://www.evidence.nhs.uk/>.
189. HSCIC. Health and Social Care Information Centre 2014.
<http://www.hscic.gov.uk/>.
190. Care Quality Commission. The Care Quality Commission. 2014.
<http://www.cqc.org.uk/>.
191. NHS England. The Information Standard. 2014.
<http://www.england.nhs.uk/tis/>.
192. NHS Choices. Health A-Z - Conditions and treatments. 2014.
<http://www.nhs.uk/aboutNHSChoices/aboutnhschoices/Aboutus/Pages/Introduction.aspx>.
193. NHS Choices. Symptom checkers. 2014.
<http://www.nhs.uk/SymptomCheckers>.
194. NHS Choices. The Information Prescription Service. 2014.
<http://www.nhs.uk/IPG/Pages/IPStart.aspx>.
195. NHS Choices. Information Prescription Service: User Guide. 2014.
[http://www.nhs.uk/IPG/Documents/IPS%20User%20Guide%20-%20Patient%206-7-11 .pdf](http://www.nhs.uk/IPG/Documents/IPS%20User%20Guide%20-%20Patient%206-7-11.pdf).
196. NHS Choices. Health Apps Library. 2014. <http://apps.nhs.uk/>.
197. NHS Choices Find GP Service. <http://www.nhs.uk/Service-Search/GP/LocationSearch/4>.
198. Digitalskills. digitalskills.com. 2014. <https://www.digitalskills.com/>.
199. UKOC. Christine gets skypeing a Start Something story. 2014.
<http://www.ukonlinecentres.com/news-or-case-study/6289-christine-gets-skypeing-a-stat-something-story>.
200. Jones RB, Ashurst EJ, Atkey J, et al. Older People Going Online: Its Value and Before-After Evaluation of Volunteer Support. *J Med Internet Res* 2015;**17**(5):e122 doi: 10.2196/jmir.3943[published Online First: Epub Date]].
201. AbilityNet. AbilityNet About Us. 2015. <http://www.abilitynet.org.uk/about>.
202. Rozenblum R, Bates DW. Patient-centred healthcare, social media and the internet: the perfect storm? *BMJ quality & safety* 2013;bmjqs-2012-001744
203. England N. Patient Online: MAKING THE MOST OF ONLINE APPOINTMENTS AND REPEAT PRESCRIPTIONS. 2015.
<https://www.england.nhs.uk/wp-content/uploads/2015/11/po-making-the-most-online-apps.pdf>.
204. HTMC. Haughton Thornley Medical Centres - Patient information portal. 2015. <http://www.htmc.co.uk/>.
205. HTMC. Haughton Thornley Medical Centres - Patient Record Access. 2015. <http://www.htmc.co.uk/pages/pv.asp?p=htmc59>.
206. HTMC. Haughton Thornley Medical Centres - A video introduction to Record Access. 2015. <http://www.htmc.co.uk/pages/pv.asp?p=htmc93>.
207. D'Alessandro DM, Kreiter CD, Kinzer SL, et al. A randomized controlled trial of an information prescription for pediatric patient education on the

- Internet. Arch Pediatr Adolesc Med 2004;**158**(9):857-62 doi: 10.1001/archpedi.158.9.857[published Online First: Epub Date]].
208. IPS N. Information Prescription Generator Tool - About. 2014. <http://www.nhs.uk/IPG/Pages/AboutThisService.aspx>.
 209. Stlevansurgery.nhs.uk. St Levan Surgery. 2016. <http://www.stlevansurgery.nhs.uk/>.
 210. ONS. Internet users in the UK: 2016. Office for National Statistics 2016
 211. Fisher J, Clayton M. Who gives a tweet: assessing patients' interest in the use of social media for health care. Worldviews on Evidence-Based Nursing 2012;**9**(2):100-08
 212. Thackeray R, Crookston BT, West JH. Correlates of health-related social media use among adults. Journal of medical Internet research 2013;**15**(1):e21
 213. Thackeray R, Neiger BL, Smith AK, et al. Adoption and use of social media among public health departments. BMC public health 2012;**12**(1):1
 214. Ofcom.org.uk. The UK is now a smartphone society - Ofcom. 2016. <https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2015/cmr-uk-2015>.
 215. Boyera S. Can the mobile web bridge the digital divide? interactions 2007;**14**(3):12-14
 216. Mobile technologies for enhancing eHealth solutions in developing countries. eHealth, Telemedicine, and Social Medicine, 2010 ETELEMED'10 Second International Conference on; 2010. IEEE.
 217. Eyrich-Garg KM. Sheltered in cyberspace? Computer use among the unsheltered 'street'homeless. Computers in Human Behavior 2011;**27**(1):296-303
 218. Xie B, Bugg JM. Public library computer training for older adults to access high-quality Internet health information. Library & information science research 2009;**31**(3):155-62
 219. Shaw B, Gustafson DH, Hawkins R, et al. How Underserved Breast Cancer Patients Use and Benefit From eHealth Programs Implications for Closing the Digital Divide. American Behavioral Scientist 2006;**49**(6):823-34
 220. McInnes DK, Li AE, Hogan TP. Opportunities for engaging low-income, vulnerable populations in health care: a systematic review of homeless persons' access to and use of information technologies. American journal of public health 2013;**103**(S2):e11-e24
 221. OFCOM. UK Home broadband performance: The performance of fixed-line broadband delivered to UK residential consumers. OFCOM 2015
 222. Trenholm R. UK leads Europe on superfast broadband, but uptake still low. 2014. <https://www.cnet.com/uk/news/uk-leads-europe-on-superfast-broadband-but-uptake-still-low/>.
 223. Support.google.com. System requirements - YouTube Help. 2016. <https://support.google.com/youtube/answer/78358?hl=en-GB>.
 224. Wali H, Hudani Z, Wali S, et al. A systematic review of interventions to improve medication information for low health literate populations. Research in Social and Administrative Pharmacy 2015
 225. Campbell JL, Fletcher E, Britten N, et al. Telephone triage for management of same-day consultation requests in general practice (the ESTEEM trial): a cluster-randomised controlled trial and cost-consequence analysis. The Lancet;**384**(9957):1859-68 doi: 10.1016/S0140-6736(14)61058-8[published Online First: Epub Date]].

226. Gavgani VZ, Shiramin AR. Physician directed information prescription service (IPs): barriers and drivers. *Aslib Proceedings* 2013;**65**(3):224-41 doi: 10.1108/00012531311330629[published Online First: Epub Date]].
227. VanGeest JB, Johnson TP, Welch VL. Methodologies for improving response rates in surveys of physicians a systematic review. *Evaluation & the Health Professions* 2007;**30**(4):303-21
228. Rice RE. Influences, usage, and outcomes of Internet health information searching: multivariate results from the Pew surveys. *International journal of medical informatics* 2006;**75**(1):8-28
229. Sinclair M, O'Toole J, Malawaraarachchi M, et al. Comparison of response rates and cost-effectiveness for a community-based survey: postal, internet and telephone modes with generic or personalised recruitment approaches. *BMC Medical Research Methodology* 2012;**12**(1):132 doi: 10.1186/1471-2288-12-132[published Online First: Epub Date]].
230. GPonline. Hunt: 95% of patients will have online access to GP records in 2015. 2014. <http://www.gponline.com/hunt-95-patients-will-online-access-gp-records-2015/article/1283771>.
231. DigitalHealth. 2015 records access promise scaled back. 2014. <https://www.digitalhealth.net/2013/10/2015-records-access-promise-scaled-back/>.
232. England N. Over 55 million patients in England set to benefit from accessing their GP record online. 2016. <https://www.england.nhs.uk/2016/07/gp-records-online/>.
233. Stevens S. Annual Report 2015/16 Performance Report. NHS England 2016
234. England N. NHS Five Year Forward View. 2014
235. Choices N. About the National Health Service (NHS). 2017. <http://www.nhs.uk/NHSEngland/thenhs/about/Pages/overview.aspx>.
236. Hawkshead J, Krousel-Wood MA. Techniques for measuring medication adherence in hypertensive patients in outpatient settings. *Disease Management & Health Outcomes* 2007;**15**(2):109-18
237. Gagné C, Godin G. Improving self-report measures of non-adherence to HIV medications. *Psychology and Health* 2005;**20**(6):803-16
238. Johnson SB. Methodological issues in diabetes research: measuring adherence. *Diabetes care* 1992;**15**(11):1658-67
239. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Science* 2011;**6**(1):1
240. Ofcom.org.uk. Infrastructure Report 2014 - Ofcom. 2015. <https://www.ofcom.org.uk/research-and-data/infrastructure-research/infrastructure-2014>.
241. Hedman E, Andersson E, Lindfors N, et al. Cost-effectiveness and long-term effectiveness of Internet-based cognitive behaviour therapy for severe health anxiety. *Psychological medicine* 2013;**43**(2):363-74 doi: <http://dx.doi.org/10.1017/S0033291712001079>[published Online First: Epub Date]].
242. Andersson E, Ljotsson B, Smit F, et al. Cost-effectiveness of internet-based cognitive behavior therapy for irritable bowel syndrome: results from a randomized controlled trial. *BMC Public Health* 2011;**11**:215
243. Hedman E, Andersson E, Ljótsson B, et al. Cost-effectiveness of Internet-based cognitive behavior therapy vs. cognitive behavioral group therapy for social anxiety disorder: Results from a randomized controlled trial.

Behaviour research and therapy 2011;**49**(11):729-36 doi:
<http://dx.doi.org/10.1016/j.brat.2011.07.009>[published Online First: Epub
Date]].