



Government
Office for Science

 Foresight

What are the likely changes in society and technology which will impact upon the ability of older adults to maintain social (extra-familial) networks of support now, in 2025 and in 2040?

Future of an ageing population: evidence review

Foresight, Government Office for Science

What are the likely changes in society and technology which will impact upon the ability of older adults to maintain social (extra-familial) networks of support now, in 2025 and in 2040?

Jacqueline Damant and Martin Knapp

**Personal Social Services Research Unit
London School of Economics and Political Science**

May 2015

This review has been commissioned as part of the UK government's Foresight Future of an Ageing Population project. The views expressed do not represent policy of any government or organisation.

Contents

Executive summary	5
Mental capacity.....	5
Social cohesion	5
Relationships.....	5
Health and social care	5
Finance and economics.....	6
Environment and infrastructure.....	6
Discussion	6
1. Introduction	7
2. Methods	9
3. Findings: mental capital through life	10
3.1 Mental capacity.....	10
3.2 Frailty.....	11
3.3 Learning styles and needs	14
4. Findings: social cohesion	16
4.1 Attitudes and aspirations.....	16
4.2 Rhetoric and framing of ageing.....	17
4.3 Trust	18
5. Relationships	20
5.1 Links with family and friends	20
5.2 Quality of life.....	21
5.3 Societal roles	21
6. Health and social care	23
7. Finance and economics	24
7.1 Patterns of expenditure.....	24
7.2 Actual and perceived affordability	24
8. Environment and infrastructure	26
8.1 Care home connectivity	26
8.2 Access to broadband	26

9. Limitations	28
10. Discussion	29
10.1 The challenges of projection	29
10.2 Enduring barriers and risks?	29
10.3 Needs and preferences.....	30
10.4 Conclusions	30
References	32

Executive summary

Information and communication technology (ICT) has become part of the social fabric of Britain and has infiltrated every aspect of daily life. However, it is estimated that 4.8 million people aged over 64 have never used the internet, raising concerns about participation in some important aspects of daily life in what is becoming an ever more digitised society. We review evidence on how changes in the period to 2040 that might occur in society and technology may affect the ability of older adults to maintain social (extra-familial) networks of support, and effects on their quality of life. 'Technology' is defined to include both traditional and new forms of social media, along with technological advances in support such as robotics and telecare.

Mental capacity

Evidence demonstrates that physical and cognitive accessibility of several ICT devices and services remain barriers to use for many older adults. But there is an evidence gap in relation to older adults' acceptance of – and access to – 'newer' touchscreen devices such as tablet computers and smartphones. Between 2010 and 2013, the proportion of older adults with internet skills grew, and more people aged 65 to 74 reported improved internet skills over the same period. However, there is evidence of a cohort effect around ICT-related skills: considerably fewer older adults have internet skills compared to younger adults. The population of older adults is highly heterogeneous, but most people with these skills have acquired them on their own, or with the help of family members and friends.

Social cohesion

ICT content is mostly directed at younger people. Older adults commonly express ambivalence about ICT and are reluctant to allow it to encroach too much into their daily lives. Many older adults believe the internet to be a threat to their privacy. Compared to the general adult population, older adults are less likely to engage with social media. ICT has the potential both to help and to harm social networking: it can help alleviate feelings of loneliness by bridging geographical distance from family members and friends, but it could also lead to the breakdown of traditional forms of social interaction.

Relationships

Older adults benefit from using ICT applications such as email and Skype to remain in contact with their family members and friends. However, ICT is often used to reinforce existing social contacts, rather than to build new ones. The effects on quality of life are mixed. Some studies show how individuals gain a sense of accomplishment and improved self-esteem from using ICT, while other studies show little or no improvement on, for example, measures of mental well-being. Older adults who use ICT appear to experience positive impacts on their level of participation in volunteer, social, religious and political activities, clubs and organisations.

Health and social care

Incorporating ICT into the delivery of health and social care services is one strategy being explored in order to address the challenge of growing needs for care while (public) resources remain constrained. There is a lot of anticipation that ICT-based services such as telecare and telehealth will develop to provide timely, personalised services to individuals, while providing

reassurance to family members and carers and also remaining socially affordable. Robust evidence to date does not support that anticipation.

Finance and economics

Many older adults receive ICT equipment or service subscriptions from family members, particularly from their adult children. Perceptions of the affordability of ICT appear to be rooted in long-established spending patterns and consumer habits, and many older adults – regardless of income – perceive ICT to be a luxury. Many express or reveal a reluctance to spend money on items that need continual updates and maintenance. Perceptions of affordability affect perceptions of the benefits of ICT.

Environment and infrastructure

The market-led approach to the roll-out of superfast broadband networks has led to geographical disparities in access to high-speed internet. Areas of the UK where over 15% of the local population have internet connections of 2 Mbit/s or less are also areas with above-average proportions of older adults in the population. Poor access to adequate broadband can exclude older adults from a number of services, including telecare and telehealth, which require reliable internet connections. Poor connectivity to the internet may also contribute to social isolation, which is a particular risk when local services, such as public transport and 'low-level' social care, are being cut. Only about 25% of registered care homes in the UK provide internet access to residents.

Discussion

It is very hard to project into the future in this rapidly changing area. Nevertheless, we are confident that older adults will make greater use of ICT over the coming years, and especially when it is helpful to them in performing everyday functions (such as shopping, banking, playing games and in personal care functions), or in maintaining or expanding social networks. But current and future devices and services will need to be designed so as to be accessible to older people, and to be perceived as affordable (and indeed actually affordable). ICT can also be a source of anxiety (about loss of privacy, fraud and identity theft, for example), and this will also need to be addressed.

There will always remain a generational gap in ICT capabilities and preferences, as well as a generational bias in the targeting of innovations and products more generally in what is a highly competitive and (if you get it right) highly profitable ICT industry. Those gaps could materially and socially disadvantage some segments of the older population. If older adults can access devices and services that meet their own needs to their full satisfaction, but without generating resentment at these inter-generational differences, then the potential for the next 25 years should be quite positive. But new technologies will need to be cognisant of, and responsive to, the needs, capabilities, resources and preferences of older adults.

Public bodies and third sector organisations may need to take action to ensure that desired ICT access is not denied to all or some older adults because of actual or perceived unaffordability, or because of physical, sensory or cognitive decline. Care settings in particular should pay more attention to the ICT-related preferences of the people they support. More generally, public action will be needed to identify which older adults use ICT to maintain or expand their social networks and which find themselves increasingly isolated, and then to respond appropriately.

I. Introduction

Today, communicating with friends and family, acquiring goods and services, and even accessing some social and healthcare services are frequently achieved through the use of information and communication technology (ICT) (Copeland *et al.*, 2014). ICT has become a key part of Britain's social fabric; it has infiltrated many aspects of daily life in Britain. ICT includes both mainstream devices and services such as the internet, mobile phones, computers, 'tablets' and digital television, as well as devices that are used to support people with social care needs or long-term conditions (e.g. telecare, telehealth and even robots).

The extent to which mainstream technologies have taken a central role in our lives is evidenced by how they have become more accessible, affordable and prevalent over the past 30 years. For instance, the first mobile phone call in the UK was made on 1 January 1985 with the Transportable Vodafone V1, which weighed 5 kg and cost in the region of £2,000 (equivalent to approximately £5,000 today) (Vodafone Limited, 2014). Only 12,000 were in circulation by the end of that calendar year. Today, the average weight of a mobile phone is 110 g (GSMArea, 2010), the average cost of a smartphone is £180 (Withers, 2014), and 93% of the UK population personally own or use one (Ofcom, 2014).

The history of the personal computer (PC) follows a similar path. In 1955 huge mainframe computers, which took up several large rooms, were available to businesses for around £500,000 at today's prices. The development of the microchip, which replaced a thousand transistors, allowed computers to be much smaller, and by the mid-1980s they had shrunk to fit easily into an average-sized room in a house. The average cost of a computer was in the region of US\$3,000 at that time (Drexler, 2007: 102), and over 30 million had been sold (The Personal Computer, 2014). Today computers are available in different forms including desktops, laptops, tablets, wristwatches and other portable devices. Prices vary, but the average cost of a PC was around US\$520 in 2009 (O'Neill, 2009), and it is estimated that there are more than 36 million PC users in the UK (Top Ten Countries with Highest Number of PCs, 2013).

The evolution of – and society's growing dependence on – ICT such as mobile phones and computers is primarily driven by the development of the internet. The history of the internet begins in the 1960s with the United States Department of Defence-funded APRANET project, which sent the first 'information packets' between network 'hosts'. In 1989, the European Organisation for Nuclear Research (CERN) created the World Wide Web, a comprehensive information exchange service over the internet. CERN 'donated' the World Wide Web to the world in 1993 by placing the technology in the public domain in 1993 (Slevin, 2000), which propelled adoption of the internet at a rapid rate: in the year of the launch of the Web there were 14 million internet users; by the turn of the century the number had grown to 413 million; and the total reached a billion in 2005. Today, there are over 3 billion internet users (www.internetlivestats.com/internet-users).

However, it is also estimated that 9.5 million adults in Britain do not have the basic skills needed to use the internet (Go ON UK, 2014), including 4.8 million people aged over 64 (Office for National Statistics, 2014a). This raises concerns about whether older adults are able to participate in important aspects of daily life – including maintaining social (extra-familial) networks of support – in what is an increasingly digitised society (Mason *et al.*, 2012). Indeed, the rapid pace of development of ICT is one of the major (but largely unknown) challenges for the future.

The aim of this Evidence Review is to examine evidence on how social and technological changes – with a particular emphasis on the internet, mobile devices and community care alarms – in the period to 2040 might affect the ability of older adults to maintain social (extra-familial) networks of support. The methods used for our review are summarised in Section 2. In Sections 3 to 8 we then discuss our findings, organising the evidence according to the six key Foresight themes: mental capital through life, social cohesion, relationships, health and social care, finance and economics, and environment and infrastructure. The limitations of our review are set out in Section 9. We then discuss some of the broader implications of these findings for the period to 2040 in our final section.

2. Methods

Evidence gathered for this review came from numerous sources. We first conducted a search of literature databases using the electronic library services of the London School of Economics and Political Science (LSE). These included Library, Information Science & Technology Abstracts, Communications & Mass Media Complete, International Bibliography of Social Sciences, PAIS International, SocINDEX with Full Text, Web of Science Core Collection, PsycINFO, CINAHL with Full Text and PubMed. Keywords reflecting the topical discourse concerning older people, digital inclusion, ICT and ICT-based care were used to construct Boolean search terms (Box 1).

Box 1: Boolean terms

Search 1: SU("older people" OR "elderly")

Search 2 TX("digital inclusion" OR "e-inclusion" OR "digital divide")

Search 3: TX("internet" OR "?phone" OR "computer" OR "digital technology")

Search 4: TX("telecare" OR "telehealth" OR "telemedicine" OR "smart?home")

Search 5: (Search 2 OR Search 3 OR Search 4)

Search 6: Search 1 AND Search 5

We conducted hand searches for policy documents and reports from, for example, the Government Digital Service and the Department of Health, as well as quasi-public and third sector organisations such as Ofcom, Age UK and the International Longevity Centre-UK. To identify relevant UK policy documents, we searched on the GOV.UK web portal, using keywords such as e-inclusion, digital inclusion and internet. The search was narrowed to certain government departments, including the Cabinet Office, Department for Culture, Media and Sport, Department for Work and Pensions, Department for Business, Innovation and Skills and Department of Communities and Local Government. A similar search on GOV.UK focused on publications from the Department of Health, with keywords such as telecare, telehealth and remote care. We hand searched CORDIS, the European Commission's repository for information on EU-funded research projects.

In our review we also include analyses of the 2011 Oxford Internet Survey (OxIS) dataset and Eurostat (from various years). The 2011 OxIS dataset was kindly supplied by the Oxford Internet Institute (OII); it offers comprehensive data on internet use by individuals aged over 13 years in Great Britain (Dutton and Blank, 2013). The surveys have been administered biannually in face-to-face interviews since 2003. Data from the latest survey (Dutton and Blank, 2013) were not available at the time of writing for external analysis. Eurostat statistics relating to the information society theme were extracted from <http://ec.europa.eu/eurostat/web/information-society/data/main-tables> (accessed 12 December 2014).

3. Findings: mental capital through life

3.1 Mental capacity

Age-related physical and cognitive decline can leave older adults facing challenges in managing their activities of daily living (ADLs) and affect their access to ICT (Age UK, 2010a). Feist *et al.* (2010) report that 30% of their sample of people aged over 54 would “use new technologies if they were easier to use”, a finding corroborated by our analysis of the 2011 OxIS dataset (Dutton and Blank, 2011): over 60% of non-internet users aged over 64 found the internet “too difficult to use”.

Several studies describe the specific ‘physical’ challenges faced by older people when using peripheral equipment (mouse, keyboard) (Hill *et al.*, 2008; Tse *et al.*, 2008), or gripping and pressing mobile phone keys or remote control buttons (Leora, 2008; Independent Age, 2010; Williams *et al.*, 2010; Hardhill and Olphert, 2012). Others describe poor accessibility for people with arthritis, tremors or ‘achy hands’ (Eastman and Iyer, 2004; Carpenter and Buday, 2007; Sayago and Blat, 2010). Deteriorating eyesight can make it hard to operate mobile phones (Leora, 2008; Williams *et al.*, 2010; Olphert and Damodaran, 2013).

There is also evidence that ICT-based *care* devices and services can be hard to access (Demeris *et al.*, 2009; Tak *et al.*, 2010; Ding *et al.*, 2011; Ludwig *et al.*, 2012). Fonts, colours and layouts of web-based applications of some telemedicine systems are not user-friendly (Demeris *et al.*, 2009). Some older users of pendant alarms find them too bulky, cumbersome and awkward to wear (Garceau *et al.*, 2007; Karunanithi, 2008; Mahoney and Mahoney, 2010; Walsh and Callan, 2011; Wagner *et al.*, 2012). Wong *et al.* (2012) found an interactive remote health consultation system hard to use by older participants. Boonstra and van Offenbeek (2010), Milligan *et al.* (2011) and Karunanithi (2008) recount how some home monitoring and community alarm services have inadequate reach, confining older adults with impaired mobility to restricted areas within their own homes. Some respondents in a study of telecare found services ‘inconvenient’ or ‘confusing’ (Lai *et al.*, 2010). Poor sound quality of audio equipment (videophone, emergency call phone) can pose difficulties for people with hearing impairments (Cheek *et al.*, 2005; Garceau *et al.*, 2007; Demeris *et al.*, 2009).

Cognitive challenges have also been identified. Age-related decline in ‘mechanical cognition’ and memory loss can affect one’s ability to navigate and retrieve information from the internet (Burmeister, 2010; Hardhill and Olphert, 2012), and difficulties may be experienced in understanding menu structures and how to navigate computer operating systems and email (Sayago and Blat, 2010). There is also evidence that some ICT-based care services are not accessible to older adults who experience declining cognitive abilities: monitoring and alarm equipment may lack memory-aid features, rendering them inaccessible to people with cognitive impairment, especially if services do not adapt as an individual’s needs change over time (Brignell *et al.*, 2007; Lauriks *et al.*, 2007; Botsis and Hartvigsen, 2008; Karunanithi, 2008; Milligan *et al.*, 2011).

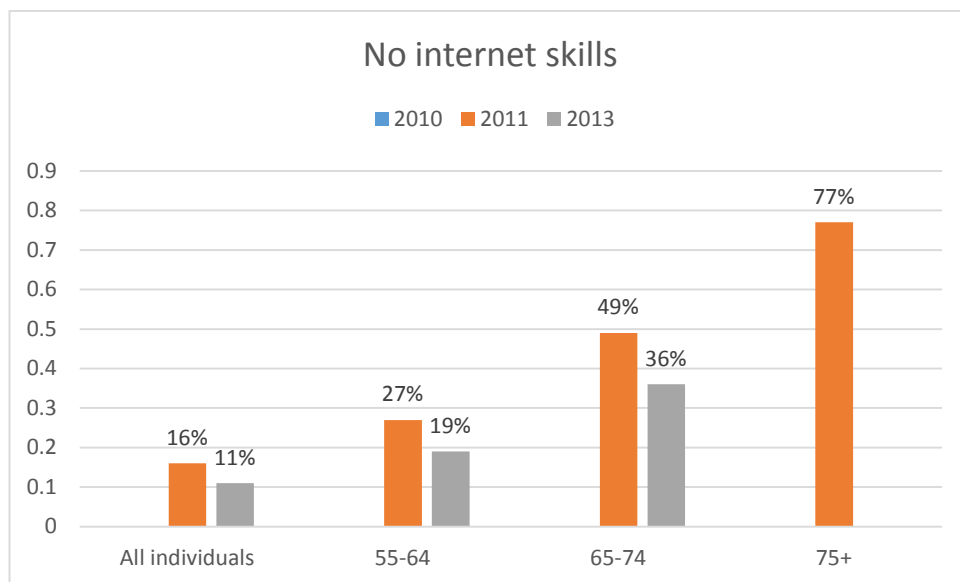
We found relatively little evidence on the accessibility of ‘newer’ touchscreen devices, such as smartphones and tablet computers. Generally, touchscreen devices were expected to be ‘age friendly’ due to their intuitive application-based interfaces and improved manipulability compared to mice and keyboards (van Isacker *et al.*, 2010; Stroud, 2011), and older participants in one study rated the “perceived ease of use” of services delivered on a touchscreen as “good”

(Wong *et al.*, 2012). Mertens *et al.* (2012) report on reduction in error rate of older adults with hand tremors when using ‘swabbing motions’ on touchscreens, compared to ‘tapping’ and ‘clicking’ techniques with a mouse. However, Sadri’s (2011) survey of ambient intelligence discovered that most older adults found tablet computer interfaces difficult to comprehend, and Alvseike and Brønnick (2012) also found that tablet computers were not effective for people with cognitive impairment.

3.2 Frailty

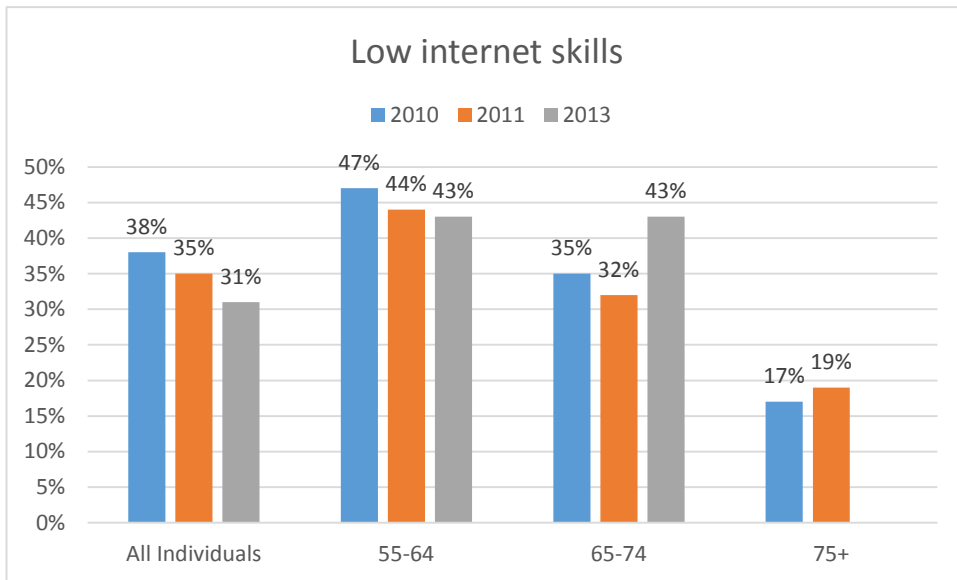
There is a ‘generational divide’ in ICT skills: older adults are less knowledgeable and have fewer skills compared to younger generations (Wright and Wadhwa, 2010; Takahashi *et al.*, 2011). Wagner *et al.*’s (2010) review of computer use by older adults reveals a strong negative relationship between age and ICT-related abilities. One reason could be that older adults have poorer operational skills needed to use the internet, such as scrolling and clicking (Leppel and McCloskey, 2011; Olson *et al.*, 2011; Mason *et al.*, 2012); another could be that they just have less experience with operating systems and software (Olson *et al.*, 2011). Dutton and Blank’s (2013) analysis of the 2013 OxlS dataset found that two-thirds of retired respondents who did not use the internet explained that they “did not know how” as a reason for non-use, compared to 57% of employed non-users.

Eurostat data also reveal generational differences in ICT capabilities: a large proportion of people aged over 64 have no related internet skill (Figures 1 to 4). Skill levels of people aged over 74 remain relatively unchanged over time, whereas among younger groups the proportions with “no or low skills” have decreased over time, and the proportions with “medium or high skills” have increased.



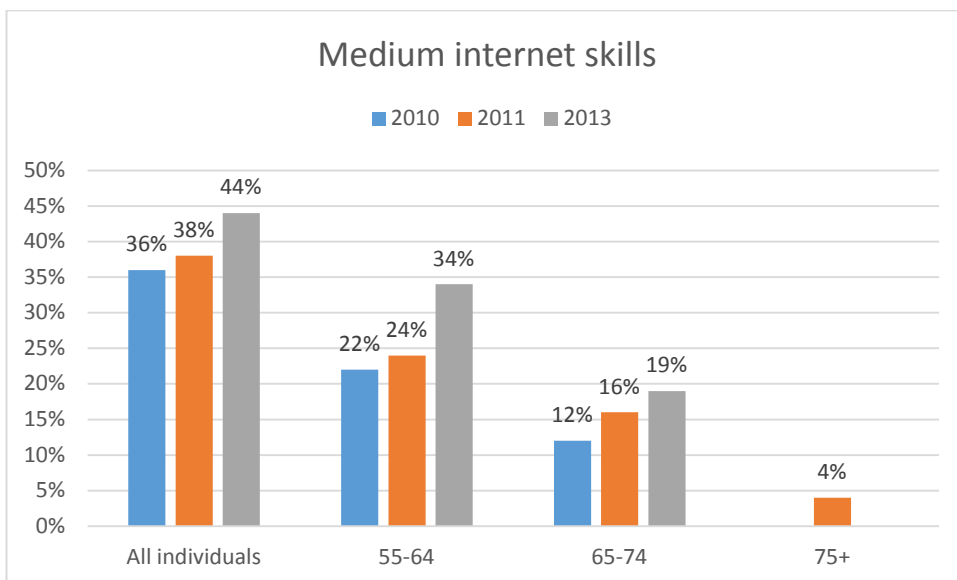
Source: Eurostat (2014).

Figure 1: Proportion of UK population with no internet skills between 2010 and 2013



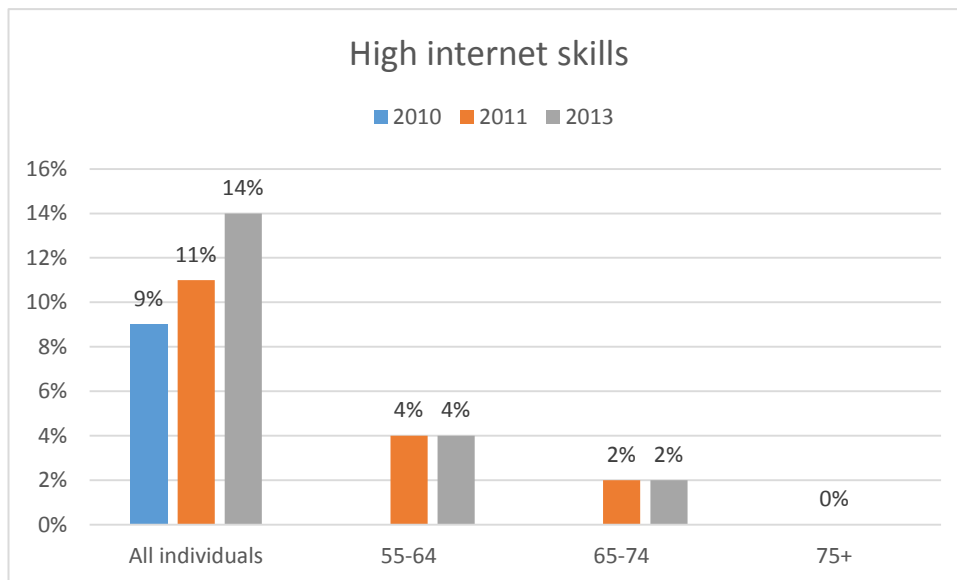
Source: Eurostat (2014).

Figure 2: Proportion of UK population with low-level internet skills between 2010 and 2013



Source: Eurostat (2014).

Figure 3: Proportion of UK population with medium-level internet skills between 2010 and 2013



Source: Eurostat (2014).

Figure 4: Proportion of UK population with high level of internet skills between 2010 and 2013

Sources: Ofcom (2013a); Office for National Statistics (2013).

The lower skill levels of older adults today could be a cohort effect, because many had left employment before or just around the time that ICT was becoming mainstream (Czaja *et al.*, 2006). Indeed, several authors have measured ICT skills according to individuals' experience and exposure to ICT (Helsper, 2008; Feist *et al.*, 2010; McMurtrey *et al.*, 2011; van Deursen and van Dijk, 2011). Slegers *et al.* (2008) demonstrate a strong association between experience and skills: heavy computer users showed greater mastery (in computer skills) compared to light computer users, illustrating how skills improve with experience. Adams *et al.*'s (2005) quantitative analysis reveals that older adults acquired more ICT skills as they increased usage of ICT. But it is a moot point whether cohort effects of this kind will ever disappear: it may be that generational differences remain but that their nature alters (see Section 10).

Some studies use level of education as a proxy measure for ICT experience and skills (through its link with employment) (Leppel and McCloskey, 2011; Mason *et al.*, 2012). There is strong evidence demonstrating positive relationships between level of attained education and adoption of ICT in the general population (Xie, 2003; European Commission, 2007; Atkinson *et al.*, 2008; Stellefson *et al.*, 2008; Randall, 2010; Wagner *et al.*, 2010; Takahashi *et al.*, 2011).

Direct links have been shown between educational attainment of older adults and use of modern ICT. Wagner *et al.* (2010) review the literature and find consistent positive relationships between education and computer use among older adults. A strong association has been found between internet use and whether respondents (of all ages) have qualifications, and attained education is a strong predictor of non-use among older adults (Mason *et al.*, 2012). Computer use and online shopping have been found to be more prevalent among older adults with education beyond age 16 (Selwyn *et al.*, 2003; Leppel and McCloskey, 2011).

3.3 Learning styles and needs

Older people are certainly capable of learning to use modern ICT (Selwyn *et al.*, 2003; Eastman and Iyer, 2004; Adams *et al.*, 2005; Independent Age, 2010). Our analysis of the 2011 OxIS dataset (Dutton and Blank, 2011) revealed that 69% of internet users aged over 64 ($n = 165$) claimed to have “worked things out on their own without help”, while a similar proportion look to their immediate social network for support (Table 1; see also Adams *et al.*, 2005; Hill *et al.*, 2008; Hernandez-Encuentra *et al.*, 2009).

Table 1: Sources of help to use the internet in the past year by people aged over 64

<i>Source of help</i>	<i>Percentage of internet users (n = 165)</i>
<i>Worked things out on their own without help</i>	68.7%
<i>Family and friends</i>	60.6%
<i>Training course</i>	17.6%
<i>Work or school</i>	12.4%
<i>Library</i>	9.7%
<i>Paid someone</i>	3.7%
<i>Internet café</i>	0.6%

Source: Dutton and Blank (2011).

Family members may act as proxy users of the internet for older adults (Morris *et al.*, 2007; Helsper, 2008). In Table 2, using OxIS 2011 data (Dutton and Blank, 2011), we show how children and grandchildren of older non-users and ex-users of the internet frequently act as proxy users, although the high proportion of ‘missing’ responses may mean that proxy use is actually underestimated.

Table 2: Sources of help to use the internet by ex-users and non-users aged over 64

<i>Source of help</i>	<i>Ex-users (n (%))</i>	<i>Non-users (n (%))</i>
<i>Friend</i>	1 (14.3)	8 (15.1)
<i>Partner/spouse</i>	0	7 (13.2)
<i>Child/grandchild</i>	7 (87.5)	51 (87.9)
<i>Sibling</i>	1 (14.3)	6 (10.9)
<i>Internet café staff</i>	0	0
<i>Library staff</i>	0	0

Source: Dutton and Blank (2011).

Many third sector organisations work to improve the e-inclusion of vulnerable groups. Organisations such as Digital Unite (<http://digitalunite.com>), Citizens' Online (www.citizensonline.org.uk), Digital Outreach and Convey (www.digitaloutreach.org.uk), the Tinder Foundation (www.tinderfoundation.org) and UK Online Centres (<http://ukonlinecentres.com/about-us/who-we-work-with>) aim to encourage ICT non-users to adopt ICT – and continue to use it – by raising awareness of the benefits of e-inclusion, providing information about devices and services, facilitating public access to computers and the internet, and developing skills of people who are digitally excluded (Age UK, 2010b; Choudrie *et al.*, 2010; Independent Age, 2010; Sourbati, 2011). Findings from Digital Outreach's Get Connected, Get Online (2010) programme show that third sector involvement has positive impacts on older people's confidence and attitudes towards the internet (Agnew and Ripper, 2011).

Some organisations run e-inclusion programmes specifically for older adults. With the support of private, public and other third sector organisations, Age UK delivers a number of nationwide programmes to promote the benefits of using ICT, including ICT courses and tutoring, outreach programmes and taster sessions. For example, in collaboration with the telecoms company EE, it ran a national 'techy tea party' to promote the benefits of being online (Age UK, 2014), building on its annual 'itea and biscuits weeks' (internet taster sessions hosted in public venues; Age UK, 2010b). Age UK also collaborates with e-inclusion charities, such as Digital Unite, to offer digital skills to older people (Digital Unite, 2014).

Other relevant skills and training programmes include UK Online Centres (2014): there are 43 'older people specialist' centres scattered across the UK to help older adults learn how to use ICT in their communities. Third sector organisations were also involved in executing the Digital Switchover Scheme: organisations such as Age UK, the Women's Institute and the Women's Royal Voluntary Service trained volunteers who visited older people to provide individual, step-by-step assistance with reconfiguring their televisions (Lewin *et al.*, 2010; Sourbati, 2011; BBC, 2014).

Third sector organisations also distribute recycled ICT equipment (e.g. laptop and desktop computers) to older adults at reduced cost (www.recycle-pc.co.uk).

It is generally acknowledged that many large corporations contribute to the third sector through sponsorship and donations of training materials. However, it has also been argued that charitable contributions made by the private sector are not proportionate to the profits they made from services which effectively exacerbated (older) non-users' isolation from the digital society (Wright and Wadhwa, 2010; Mason *et al.*, 2012). Indeed, researchers suggest that private corporations should extend their social responsibility obligations (Mason *et al.*, 2012) by offering more accessible after-sales support (Hernandez-Encuentra *et al.*, 2009), specifically tailored to the needs and capabilities of older customers.

4. Findings: social cohesion

4.1 Attitudes and aspirations

Positive attitudes lead to ICT adoption (Helsper, 2008; Age UK, 2010b; Feist *et al.*, 2010; Berry, 2011; Mason *et al.*, 2012), but many studies describe older people's negative attitudes and anxieties about using mainstream ICT. Specific concerns include breaking equipment, internet fraud, abuse of personal information, perceived health risks such as radiation, and bad experiences with computer viruses (Hill *et al.*, 2008; Independent Age, 2010; Wright and Wadhwa, 2010; Leppel and McCloskey, 2011; Mason *et al.*, 2012; Dutton and Blank, 2013).

Attitudes vary, of course. Reviews by Wagner *et al.* (2010) and Xie (2003) suggest that as age increases, attitudes towards ICT become more negative. Empirical evidence from Feist *et al.* (2010) show that people aged 65 to 79 demonstrate strongly positive attitudes towards ICT, whereas people aged over 79 are distinctly more negative. Older adults are less confident in their computer skills compared to younger people (Marquié *et al.*, 2002); and in one study, 60% of participants aged over 79 felt "too old" to learn about new technologies, compared to 22% of people aged 65 to 69, and 9% of participants aged 55 to 64 (Feist *et al.*, 2010).

There may be gender differences in attitudes. Wagner *et al.*'s (2010) review found that, overall, men experience less computer-related anxiety and have more positive attitudes than women (and see Czaja *et al.*, 2006; Koch and Hägglund, 2009; Singh *et al.*, 2009; Lai *et al.*, 2010). Results from the analysis of the 2011 OxIS dataset (Dutton and Blank, 2011) demonstrated that a significantly larger proportion of older women had never used the internet (73.2%) compared to older men (56.3%).

However, the evidence suggests that for the adult population as a whole, the gender gap in ICT use is narrowing. Dutton and Blank (2013) demonstrated that in 2003, 55% of female and 64% of male respondents used the internet, whereas in 2013, the percentages were 78% and 79%, respectively. Seale *et al.* (2006) also found no differences in the proportion of men and women using the internet to search for health information. Rather, they noted differences in the types of health information sought: men tended to seek instrumental information around interventions and procedures related to their illness, while women sought emotional and social support.

Dutton and Blank (2013) did uncover gender differences in internet self-efficacy: 70% of women and 77% of men rated their internet ability as excellent or good. However, the difference between the genders in attitudes towards ICT is narrowing: this 7-point difference in 2013 was 5 percentage points smaller than the difference recorded in 2011.

There is little evidence on differences in attitudes towards ICT between people from different ethnic backgrounds. For instance, Littlechild and Barr (2013) did not find a significant relationship between ethnicity and the likelihood of using the internet for breast cancer information in a sample of adults aged 20 years and older in South Manchester (UK), although they did note that this null finding could have been due to the small number of participants in the study who were from ethnic minorities. Huang *et al.*'s (2014) study of white, black and Hispanic internet users (aged 35 years and older) in the USA uncovered significant gaps in awareness of various health issues between the white group and the other two groups, with these gaps closely associated with differences in online information-seeking behaviours, underlying health knowledge, trust of online information, education and religious beliefs between the groups.

Overall, the evidence suggests that older adults are deeply ambivalent towards ICT (Xie, 2003; Selwyn, 2004; Helsper, 2008). Several studies note that older adults use ICT for only limited purposes (Wagner *et al.*, 2010; Olson *et al.*, 2011), and only when it does not interfere with their daily lives (Selwyn, 2004; Hernandez-Encuentra *et al.*, 2009). Paul and Stegbauer (2005) report how older adults perceive the internet to be interesting, but that it offers too little content in relation to their needs. Participants in the study by Hill *et al.* (2008) expressed the view that the internet was useful for communicating with others and as an educational tool, but did not find it useful for shopping or banking, as these were considered intrusions into daily routines. Dutton and Blank (2011) found that 30% of retired respondents did not use – or had ceased to use – the internet because they perceived it to be “too time consuming” (p. 57), suggesting that ICT was a distraction from other activities. Feist *et al.* (2010) show that perceived lack of usefulness decreases with age: 43% of participants aged 55 to 64 agreed that “new technologies are very useful”, compared to 32% aged 65 to 79 and 10% aged over 79. Other studies have also concluded that perceptions of the relevance and ‘added value’ of ICT are crucial to the e-inclusion of older adults (Czaja *et al.*, 2006; Age UK, 2010b; Choudrie *et al.*, 2010; Sinclair, 2010; Weaver *et al.*, 2010).

Evidence on ways in which older adults find ICT to be relevant and beneficial to their lives comes from a number of studies. Hernandez-Encuentra *et al.* (2009), Walsh and Callen (2011), Martinez-Pecino *et al.* (2012), and Hardhill and Olphert (2012) show that older adults commonly perceive mobile phones as useful in emergencies. Adams *et al.* (2005), Carpenter and Buday (2007), Sayago and Blat (2010), and Dutton and Blank (2013) report that older adults welcome a computer for accessing the internet in order to communicate with friends and family via email or Skype. Selwyn *et al.* (2003), Dutton and Blank (2011), Olson *et al.* (2011) and Robertson-Lang *et al.* (2011) show that many older adults see the internet as useful for accessing a range of information. Koopman-Boyden and Reid (2009) and Choudrie *et al.* (2010) discuss older adults’ use of the internet for making travel arrangements and pursuing hobbies. Only a minority of older ICT users appear to find the internet beneficial for online shopping and banking (Morris *et al.*, 2007; Stroud, 2012) or playing games (Choudrie *et al.*, 2010; Plaza *et al.*, 2011).

4.2 Rhetoric and framing of ageing

As we have seen, many older adults do not perceive mainstream ICT to be relevant to their needs *at their stage in life* (Roberts, 2009). The Age UK report *The Golden Economy* (2010b) cited the widely held view that most internet content was directed at the ‘youth culture’ and tended to alienate older adults. Dutton and Blank (2013) reported that over two-thirds (67%) of their retired sample who did not use the internet claimed that their non-use was because it “was not for people of my age”. The Ofcom *Communications Market Report* (2011) notes that 24% of people aged over 64 feel they are “too old” to use the internet. The age gradient in Feist *et al.* (2010) was 44% of those aged over 79 claiming that ICT was of no use to their lives, compared to 12% aged 55 to 64 and 18% aged 65 to 79.

Of course overall, many older adults do adopt ICT, perceiving it to be relevant to their lives, albeit with mixed feelings about it encroaching on their daily routines or challenging their self-perceptions as able and independent. Moreover, the common expression of “lack of interest” among people who do not use ICT could suggest resistance to the established ‘digital order’. This has led many observers to question whether this expressed reluctance is based on informed judgements, or whether it reflects underlying anxieties, low skills or financial concerns (Berry, 2011; Ofcom, 2012).

The force of the digital culture is also highlighted in evidence concerning accessibility, revealing an industry-wide focus on youth which has led to a systematic disregard for the needs, preferences and capabilities of older adults. There even appears to be a tendency in the literature to blame older adults, rather than (say) ICT design, for their lack of engagement, reinforcing the view that older adults should adapt to ICT, rather than considering how ICT might be adapted to suit their circumstances and needs (Hernandez-Encuentra *et al.*, 2009).

The growing 'silver economy' has been widely touted as a potentially lucrative market opportunity, and an important driver for encouraging older people's digital inclusion (Timmers, 2008; Finn and Wright, 2011; McMurtrey *et al.*, 2011). However, Wright and Wadhwa (2010) and Plaza *et al.* (2011) noted the practical difficulties in developing marketable ICT applications for older consumers who do not have an online presence. Furthermore, it was suggested that if a clear business case existed for age-friendly ICT products, it would already have been pursued (Independent Age, 2010).

The challenges around the development of ICT for older people are evident in age-specific marketing campaigns, which often emphasise infirmity and frailty (Roberts, 2009; Price, 2011), an image with which only a minority of older people identify (Independent Age, 2010). For example, Berry (2011) found that social networking sites designed for the older market were unattractive as they segregated older people from mainstream users. Furthermore, several researchers commented on the stigmatising effect of ICT-based care services, such as monitoring services and wearable devices, which implied to older users that they were becoming increasingly frail, disabled and dependent (Karunanithi, 2008; Sixsmith and Sixsmith, 2008; Roberts, 2009; Lloyd, 2010; Age UK, 2010b; Ding *et al.*, 2011; Zweijssen *et al.*, 2011; Sanders *et al.*, 2012; Wagner *et al.*, 2012).

4.3 Trust

Several sources reveal that many older adults fear using ICT will have a negative effect on their sense of privacy and personal security (Wright and Wadhwa, 2010; Leppel and McCloskey, 2011; Mason *et al.*, 2012). The 2011 OxIS survey offers some support for this view: 54% of the sample ($n = 467$) "agreed" or "strongly agreed" that the "present use of computers and the internet are a threat to privacy in this country" (Dutton and Blank, 2011). Others have pointed to fears about becoming victims of abuse and crime when using ICT, including identity theft, and the effects on one's personal sense of security (Gatto and Tak, 2008; Hill *et al.*, 2008; Wright and Wadhwa, 2010). For instance, the data in Table 3 demonstrate that, compared to younger age groups and the adult population as a whole, only a small proportion of older adults use social media.

Table 3: Social media activities undertaken by UK adults¹ and use of social media (2013)

<i>Activity</i>	<i>Total (16+)</i>	<i>16–24</i>	<i>55–64</i>	<i>65+</i>
<i>Sharing links to websites or online articles on social media sites/apps²</i>	38%	61%	12%	9%
<i>Looking at social networking sites/apps</i>	69%	96%	37%	30%
<i>Using instant messaging on mobile phone</i>	38%	72%	12%	5%
<i>Using a mobile phone to put photos or videos on Facebook or Instagram</i>	38%	68%	9%	3%

Notes

¹ Percentages represent the proportions of adults who use the internet, not of total adult population.

² For example Twitter, Facebook, Reddit, LinkedIn.

Source: Ofcom (2014).

5. Relationships

5.1 Links with family and friends

The wide geographical dispersal of families, coupled with smaller average family size, leave many older adults isolated and lonely, with serious consequences for physical and mental health (Department of Health, 2012; Courtin and Knapp, 2015). ICT use might help combat these risks. Mason *et al.* (2012) report how older non-internet users were significantly more likely to say they felt lonely compared to older internet users. Tsai *et al.* (2010) reported that older adults living in residential care significantly reduced their level of loneliness from baseline to follow-up when using video-conferencing equipment. Similarly, Blažun *et al.* (2012) found that older adults living in residential care who use email and online forums reduced their levels of loneliness.

Many other sources note that the primary benefit of older adults' use of ICT – mobile phones, email, Skype or internet – is the ability to maintain relationships with friends and family and thereby gain social support (Age UK, 2010b; Choudrie *et al.*, 2010; Independent Age, 2010; Weaver *et al.*, 2010; Wright and Wadhwa, 2010; Plaza *et al.*, 2011; Blažun *et al.*, 2012; Bobillier Chaumon *et al.*, 2013; Mason *et al.*, 2012). A secondary benefit is improvement of inter-generational relationships (Sayago and Blat, 2010; Bailey and Ngwenyama, 2011). Woodward *et al.* (2011) report greater perceived support from friends by older adults who took part in ICT training.

Not all studies find such resoundingly positive associations between ICT use and social involvement and participation. Weaver *et al.* (2010) find only a small minority of older participants using a computer to maintain family contact, and often utilisation was because it was the only way to maintain contact with grandchildren. Koopman-Boyden and Reid (2009) report no significant relationships between older adults' use of the internet/email and contact with family and others. Slegers *et al.* (2008) report no significant links between loneliness with friends (in general) and computer and internet usage. Woodward *et al.* (2011) found no significant reductions in loneliness among older participants who received ICT training.

Indeed, some studies suggest *negative* effects of ICT use on older adults' social involvement and participation. Huang's (2010) meta-analysis (not restricted to studies exclusively of older adults) suggests a negative association between high internet use and well-being. Slegers *et al.* (2008) report that older adults receiving computer training saw their intimate friends significantly less often at follow-up than at baseline; and Sum *et al.* (2008) conclude that social and family loneliness for older adults is *positively* correlated with amount of time spent using the internet.

Several sources in the literature have highlighted the influence of informal networks on older people's level of e-inclusion. Selwyn *et al.* (2003), Morris *et al.* (2007) and Heart and Kalderon (2013) showed that living with a partner had significant positive effects on older adults' adoption of ICT. These findings were also reflected in ONS estimates (Office for National Statistics, 2014b), which suggest that households with two adults, where one adult was at least 65 years old, were almost twice as likely (80%) to have an internet connection compared to households consisting of a single adult 65 years or older (41%). According to the 2011 UK Population Census, over 33% of people aged over 64 in England and Wales lived alone (Office for National Statistics, 2014a).

There are therefore potentially both positive and negative outcomes for social networking from ICT use. At its best, ICT can reinforce existing relationships, but there is no clear evidence that it *expands* social networks. For instance, Sayago and Blat (2010) found that older adults did not use email to make new friends, but rather relied on traditional methods that were perceived to be 'safer'. Sum *et al.* (2008) note that using the internet to communicate with new people was associated with higher levels of loneliness.

5.2 Quality of life

ICT use can have positive effects on well-being. Sayago and Blat (2010) recount the enjoyment and sense of purpose experienced by older adults when using email to communicate with loved ones. Hill *et al.* (2008), Gatto and Tak (2008) and Independent Age (2010) note how older adults experience a "sense of accomplishment", feelings of empowerment and increased self-esteem from using email and the internet; and the Sus-IT project (2011) reports that going online can make older adults feel mentally alert and challenged, and subsequently more youthful (Independent Age, 2010). Similar findings are offered by Koopman-Boyden and Reid (2009) and Erickson and Johnson (2011). Older adults in residential care using a video-conferencing service had a significant drop in depressive symptoms 3 months later (Tsai *et al.*, 2010). Slegers *et al.* (2008) found that older adults who were interested in – and used – a computer and the internet had lower anxiety levels than older adults not interested in using ICT, while Cresci *et al.* (2010) report significantly higher levels of what they call 'senior optimism' in older computer users compared to non-users.

In contrast, Mason *et al.* (2012) find a weak association between anxiety and internet use, and Woodward *et al.* (2011) find no decrease in depressive symptoms in older adults using ICT, although participants started with low depression levels.

Regression analyses of the OxIS 2011 data (Dutton and Blank, 2011) by one of the authors demonstrated a significant, negative relationship between having a limiting health problem or disability and level of digital inclusion among people aged 65 years and older living in the community (Damant, 2015). This suggests that older people with long-term conditions have fewer opportunities to engage with mainstream ICT, and are at greater risk of exclusion from the digital society. Yet ICT may present a real opportunity to reduce social exclusion and to improve self-management of chronic conditions, thus improving their quality of life.

5.3 Societal roles

There is strong evidence that using ICT has a positive effect on older adults' ability to carry out work, leisure, hobbies and information seeking (Selwyn, 2004; Slegers *et al.*, 2008; Gatto and Tak, 2008; Choudrie *et al.*, 2010; Independent Age, 2010; McMurtrey *et al.*, 2011; Plaza *et al.*, 2011). ICT use can support active participation in associations of all kinds, including social, religious, political and tenant associations, clubs and organisations. Koopman-Boyden and Reid (2009), Cresci *et al.* (2010) and Mason *et al.* (2012) note that older internet users are significantly more likely to take up leadership roles in social and community clubs and organisations. Older adults use email to coordinate their volunteering activities (Harrod, 2010; Mukherjee, 2011). Other studies suggest that older adults who participate in ICT-based activities, such as online shopping, banking and playing games, are actually in the minority (Selwyn *et al.*, 2003; Selwyn, 2004; Choudrie *et al.*, 2010; Erickson and Johnson, 2011). The findings in Table 4 also demonstrate that only a small fraction of the older population use games consoles and portable media.

Table 4: Devices used at home to access the internet by age in 2012

Device	All adults	16–24	55–64	65–74	75+
<i>PC or laptop</i>	74%	90%	71%	47%	16%
<i>Mobile phone</i>	53%	83%	35%	14%	2%
<i>Games console</i>	16%	32%	6%	1%	0%
<i>Portable media</i>	12%	30%	7%	1%	0%
<i>Tablet</i>	16%	23%	10%	5%	1%

Source: Ofcom (2013b).

6. Health and social care

Another Evidence Review commissioned by the Foresight programme is looking at ICT-based services such as telecare, telehealth and robotics. We do not therefore discuss this area in this review. However, we would note that there is evidence that some older adults decline to accept telecare services, for example because of the loss of social contact that results. As Sanders *et al.* (2012) describe from the large WSD trial: “Comments regarding current services indicated that respondents were reluctant to disrupt services that were currently working well and that they often valued highly. Much of this satisfaction seemed to be associated with stable relationships that had been developed with specific service providers and there were concerns about what changes the equipment might bring to those relationships.” Health and social care professionals are seen as part of the (extra-familial) networks of some older adults.

It has also been demonstrated how some telecare devices can be used to provide reassurance to (geographically distant) family members and carers that all is well, or at least that some aspects of their older relatives’ lives are being monitored (e.g. Cardozo and Steinberg, 2010; Matthews *et al.*, 2010; Walsh and Callan, 2011).

7. Finance and economics

7.1 Patterns of expenditure

Older adults' informal networks are important intermediaries in their access to ICT. Interview data from Selwyn (2004) and Hill *et al.* (2008) reveal that few older participants in their studies purchased computers themselves; rather they acquired them through their adult children. Martinez-Pecino *et al.* (2012) found that 53% of older participants in their study acquired their mobile phones as gifts.

Older adults' perceptions of the affordability of – and subsequent patterns of expenditure on – ICT are rooted in their values about spending and their related consumption habits, with ICT perceived as a luxury good, rather than a tool for improving life quality (Weaver *et al.*, 2010). Indeed, observations made in the Age UK report *The Golden Economy* (2010b) suggest that older adults, regardless of income, are more hesitant about spending compared to younger generations: 45% of people aged 65 years and older with the highest income levels had the lowest levels of expenditure, compared to 27% of people aged 30 to 49 years.

Although many older adults build up substantial savings over their lifetime, many remain cautious about spending money on goods and services such as ICT that have ongoing costs (Haddon, 2000). Independent Age (2010) note that older adults' concerns about the escalating costs of maintaining, updating and replacing hardware, software and security packages influenced their perception of affordability – and thence adoption – of ICT.

7.2 Actual and perceived affordability

Higher-income households are more likely to own and use ICT than lower-income households (Randall, 2010; Ofcom, 2013b). Indeed, Dutton and Blank (2013) report a widening gap in access to ICT between higher and lower income groups between 2011 and 2013. For older adults specifically, there is a strong association between income and access to ICT (e.g. Carpenter and Buday, 2007; Atkinson *et al.*, 2008; Mason *et al.*, 2012). While income is an objective indicator of purchasing power, older adults' *subjective perceptions* of affordability of ICT are powerful determinants of their e-inclusion (Hill *et al.*, 2008; Independent Age, 2010; Wagner *et al.*, 2010). Turgeon-Londei *et al.* (2009) report that older adults with very little experience of mobile phones, DVD players and computers cite affordability as a very common reason for not using them. Feist *et al.* (2010) found that approximately 30% of people aged over 64 agreed that “technologies were too expensive for me”.

Perception of affordability affects perception of the benefits of ICT. Older adults who perceive ICT as unaffordable are more likely to discount the value of – and their need for – ICT, and consequently are less likely to acquire it (Czaja *et al.*, 2006). In a similar vein, Wagner *et al.* (2010) and Hill *et al.* (2008) suggest non-use is often attributed to lack of perceived benefit as a result of perceived unaffordability. In fact, the Ofcom *Communications Market Report* (2012) and Selwyn (2004) suggest that some older adults are uncomfortable about admitting that cost is a factor and give alternative reasons for non-use of ICT.

There is evidence that health and social care reimbursement policies have an effect on older adults' perceptions of the affordability of ICT, and consequently their access to ICT-based care (Chan *et al.*, 2009; Singh *et al.*, 2009; Zweijssen *et al.*, 2011). Harjumaa and Isomursu (2012)

and Tse *et al.* (2008) report that older adults perceive the costs of ICT-based care services that rely on mainstream devices (e.g. laptop computers or mobile telephones) and networks (e.g. internet connection) as high when they were not reimbursed for new equipment. Nijland *et al.* (2009) found that older adults were significantly more likely than younger people to cite “lack of reimbursement” as a barrier to use of e-consultation (with a GP) services. Another study concluded that a sense of guilt from spending their savings on themselves (buying ICT-based care services) rather than passing them onto their children was a barrier to adoption (Garceau *et al.*, 2007). There are many other studies of telecare that reach similar conclusions.

8. Environment and infrastructure

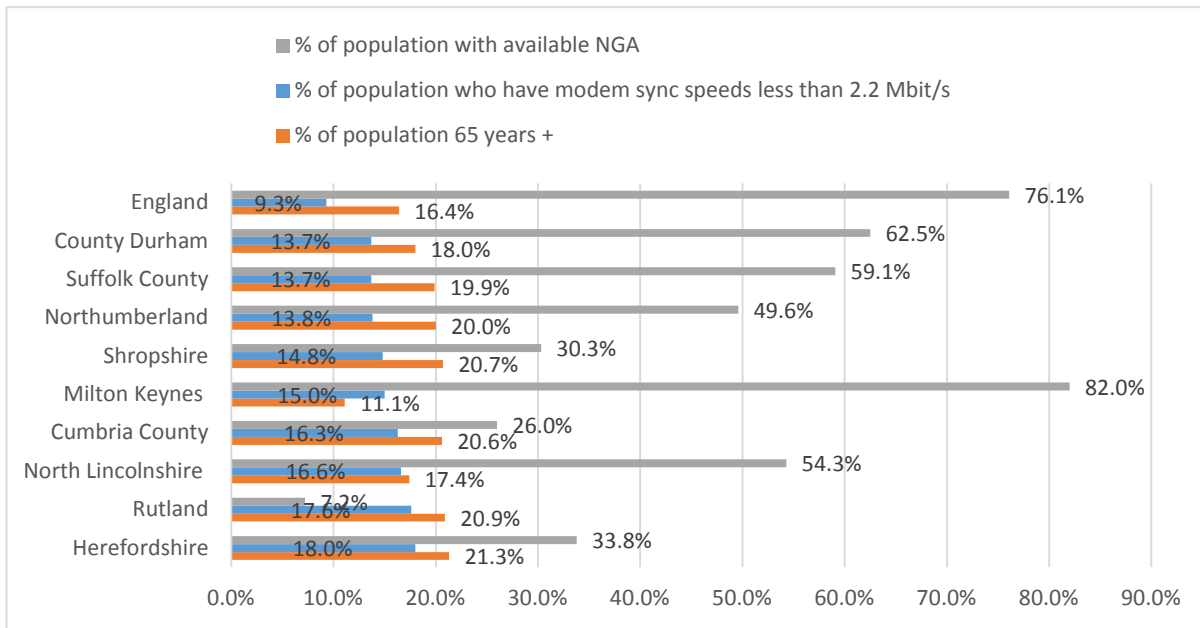
8.1 Care home connectivity

Some providers of special housing and care homes have installed internet connections, but access is generally very poor: according to carehome.co.uk (2014), of the over 20,000 care homes in the UK, only 4,178 provide access to the internet. Some housing associations have commissioned telecare services, such as community alarms and 24-hour monitoring services (Aragon Housing Association, www.aragon-housing.co.uk; Technology Services Association, 2013), with alerts sent to a response centre or, in some cases, to family members or friends (Technology Services Association, 2013). Care provider managers and staff have given very low priority to the 'connectivity needs' of the people they support. Initiatives such as My Home Life (<http://myhomelife.org.uk>), which aim to improve quality of life of older people living in residential care, could be instrumental in raising awareness of the changing connectivity needs of older people.

8.2 Access to broadband

Partly as a result of the Government's market-led approach to the modernisation of the internet infrastructure (Department for Business Innovation and Skills, and Department for Culture, Media and Sport, 2009) there are geographical disparities in 'next generation access' (NGA) networks across the UK. The initial roll-out was concentrated primarily in more densely populated and affluent areas, where internet use was already higher (Ferro *et al.*, 2011; Ragoobar *et al.*, 2011; Vicente and Lopez, 2011; Communications Consumer Panel, 2012), and where the return on investment is most assured (Ragoobar *et al.*, 2011).

Figure 5 shows the administrative authorities in England with the highest proportion of households with internet services of less than 2 Mbit/s. Also shown is the proportion of the population in each area with access – although not necessarily subscription – to NGA internet. Finally, the figure shows the proportion of people aged 65 years and older living in these authorities. The information in this figure demonstrates that in the nine administrative authorities with the poorest levels of internet speed, between 14% (Suffolk) and 18% (Herefordshire) of the local population are affected. Eight of these nine authorities (the exception is Milton Keynes) have an older population above the English national average of 16.4%. Level of access to NGA networks in eight authorities (again, the exception is Milton Keynes) is lower than in England as a whole: the proportion of the population with access to NGA ranges from 7% (Rutland) to 63% (County Durham), which is lower than the England average of 76%. The market-led NGA roll-out inherently discriminates against areas with large older populations. Older residents in areas with a poor internet infrastructure are limited to basic internet functions and unreliable connections, and are at risk of becoming progressively more disadvantaged (Mason *et al.*, 2012).



Source: Ofcom (2013a), Office for National Statistics (2013).

Figure 5: Areas in England with highest rates of access to less than 2 Mbit/s (2013)

9. Limitations

Our review has limitations. Our brief was not to cover access to, or use of, ICT in health and social care contexts, including telecare, telehealth, smart housing and robotics. There are a number of topics that are common to 'mainstream' and care-related ICT, such as accessibility, privacy and the effects of use on individuals' social networks. However, there are other topics unique to the ICT-based care market and which require specific analysis. For instance, many ICT-based services are designed for, and employed by, unpaid (informal) carers of older adults with care needs, which raises issues about support and funding; these are covered in a separate review.

There is little research on how different groups *within* the older population use the internet, despite its inherent heterogeneity. Some distinctions are made between 'younger' and 'older' subgroups in terms of their attitudes towards and use of ICT, and some studies have examined differences by gender or level of education. But there is very little empirical research on whether older adults' views on and use of ICT differs by ethnicity, religious beliefs, rural versus urban living, political views or even household composition. Indeed, our review finds that, most commonly, studies of older adults' use of ICT treats people aged 65 years and older as a single, homogenous group.

Investigation of the effects of ICT use on quality of life is also a relatively neglected topic, and the available empirical evidence is hindered by methodological limitations such as small samples, and a tendency for each new study to want to employ a different instrument to measure quality of life, making it hard to make comparisons or pool findings.

It is also hard to quantify the social outcomes of ICT use. Hirani *et al.* (2014) suggested that the mixed findings from the WSD trial related to the effects of telecare use on depression and anxiety could be due to the complex emotions older people experience when they have care needs, implying that the relationship between the use of ICT-based care and mental well-being is not linear. In general, the relationship between people and digital era technology is complex, and ethnographic research methods may be more suitable for exposing the underlying causes and effects of ICT use.

10. Discussion

10.1 The challenges of projection

Projections of the future are usually quite heavily influenced by experiences of, and perhaps extrapolations from, the past. Reviewing what the likely changes might be in society and technology over the period to 2040, and their implications for the ability of older adults to maintain social (extra-familial) networks of support is especially challenging. ICT develops at a very rapid (indeed accelerating) pace: 25 years ago, everyone was getting excited by fax machines, so trying to imagine what new technologies might be available 25 years from now is very hard. This makes it hard to speculate how future technologies may affect future generations of older adults as they explore and negotiate their roles in society.

Support from outside the family can come from various sources: from close friends, neighbours and members of an individual's wider community (including a virtual community); and from staff employed by 'formal' health, social care, housing and other services. We have focused our review on the interplay between individuals in these 'networks' and the use of ICT, such as the internet, email, social media, mobile phones and tablets. One element of this – particularly in the context of an ageing population and a new political determination to rein in public expenditure – is to see ICT-based services as the solution to the challenge of meeting health and social care needs. Yet the evidence to date is not inspiring, if the results from the only large, independently funded trials can be taken as indicative (Sanders *et al.*, 2012; Steventon *et al.*, 2012; Cartwright *et al.*, 2013; Henderson *et al.*, 2013, 2014; Hirani *et al.*, 2014). If ICT-based services can be streamlined and personalised, then they may have important contributions to make.

10.2 Enduring barriers and risks?

Many of the evidenced barriers to the use of ICT by older adults today are likely to continue to be relevant over the coming decades. Some of the various observed 'facilitators' to the use of ICT evident from recent studies might also be expected to have ongoing relevance for the future, albeit in rather different contexts. What then might be expected for the next 25 years?

Do the negative attitudes towards ICT demonstrated by some older adults – particularly the lack of perceived benefits – stem from some form of resistance to the 'new digital order', especially because ICT is seen as primarily designed for younger generations? There would certainly appear to be support for this supposition, even though there are very many older adults determined to use ICT (and completely self-reliant on it). Over time there may develop a sufficiently large 'grey ICT market' (if one can use such an expression) to persuade the industry to better understand the needs and preferences of older adults, and then to respond with affordable, accessible products. But the highly competitive ICT sector is not going to shift the main focus of its attention away from the very profitable younger generation market, fashioning new technologies to suit (and shape) their lifestyle choices. But if older adults can access ICT devices and services that meet their own needs to their own satisfaction – using a smaller set of functions and applications than younger adults – and without feeling in some sense resentful about such inter-generational differences or 'excluded' because cutting-edge technologies are not easily accessible to them, then the potential for the next 25 years is nevertheless quite positive.

For this to happen, new technologies will need to be responsive to the needs, capabilities, resources and preferences of older adults. Age-related deterioration in physical, sensory and cognitive abilities will need to be taken into account. Opportunities for learning new skills (beyond those acquired during the years of paid employment perhaps, and/or adapted to new personal capabilities) will need to be developed. Public bodies and third sector organisations may need to take action to ensure that desired ICT access is not denied to older adults because of actual or perceived unaffordability, although spending patterns are quite likely to change, with the result that ICT may be seen as more of an 'essential' good or service than is perhaps the case today. They will also need to address genuine but perhaps unfounded (or at least exaggerated) fears of exploitation, fraud and identity theft. Care settings – including day facilities, housing complexes or care homes – will need to pay much more attention to the ICT-related preferences of the people they support or accommodate. Those individuals are likely to face the biggest practical obstacles to using ICT (because of poor eyesight or dexterity, perhaps, or through cognitive decline) yet could also benefit enormously from the social networking that ICT can facilitate. To date the care sector has largely ignored the 'connectivity needs' of individuals, particularly older adults.

10.3 Needs and preferences

ICT can be seen as a way to meet a range of needs and to satisfy a range of wants. Some health-related needs might be met (or at least monitored) by new generations of telehealth technologies. Help with some activities of daily living (ADLs) and instrumental activities of daily living (IADLs) could come through new generations of telecare, and perhaps through advanced robotics. But each of these ICT-based services involves replacing personal contact with something impersonal – or a-personal – which could therefore create new or different needs for social contact and participation.

If evidence that has accumulated to date is a pointer to trends for the future, ICT has the potential both to help and to harm. ICT can help alleviate feelings of loneliness but also increase the risks of it occurring. It can help bridge large and small geographical distances between dispersed family members and friends, but we know that today older adults who live alone are less likely to have a home internet connection: some ICT can only be a vehicle for social networking if the person is online. There is also the danger that ICT could be responsible for the breakdown of traditional forms of social networking to which many older adults have become fondly accustomed over their lives: meeting acquaintances in the supermarket, high street or bank queue; sitting in the GP waiting room; being visited at home by the community nurse; spending an afternoon at the bingo or the bridge club; or just popping round to a neighbour for a cup of tea and a chat. Today's ICT could easily replace every one of those activities in the future. After all, the evidence presented in this review implies that for many younger adults, ICT – and particularly internet connectivity – plays a central role in their daily lives (Dutton and Blank, 2013), in contrast to today's older people, who tend to use ICT more peripherally. This suggests that traditional forms of social networking in the future could also have an ICT focus. So while the potential for new technology over the next 25 years to replace centuries old conventions of social networking is considerable, we do not know for whom or in what circumstances that would be either good or bad.

10.4 Conclusions

Older adults will increasingly use ICT when it is helpful to them, whether for various functions important in their daily lives (including shopping, banking, playing games and personal care functions), and to maintain or expand their social networks. But for this to happen, current and

future devices and services must be designed to be accessible and affordable to them, and not to be sources of anxiety. There will always be a generational gap in capabilities and preferences, and a generational bias in the targeting of major innovations in the ICT market, and those gaps could materially and socially disadvantage some segments of the older population. Public action will be needed to identify which older adults use ICT to maintain or expand their social networks and which find themselves increasingly isolated, and then to respond appropriately.

References

- Adams, N., Stubbs, D. and Woods, V. (2005) *Psychological barriers to internet usage among older adults in the UK*. *Medical Informatics and the Internet in Medicine* 30(1), 3–17.
- Age UK (2010a) *Technology and Older People: Evidence Review*. London: Age UK.
- Age UK (2010b) *The Golden Economy*. London: Age UK.
- Age UK (2014) *Techy Tea Party*. Available at: www.ageuk.org.uk/work-and-learning/technology-and-internet/techy-tea-party/ (accessed 6 June 2015).
- Agnew, I. and Ripper, L. (2011) *Using embedded outreach to bridge the digital divide*. *Working with Older People* 15(3), 127–134.
- Alvseike, H. and Brønnick, K. (2012) *Feasibility of the iPad as a hub for smart house technology in the elderly; effects of cognition, self-efficacy, and technology experience*. *Journal of Multidisciplinary Healthcare* 5, 299–306.
- Atkinson, J., Black, R. and Curtis, A. (2008) *Exploring the digital divide in an Australian regional city: a case study of Albury*. *Australian Geographer* 39(4), 479–493.
- Bailey, A. and Ngwenyama, O. (2011) *The challenge of e-participation in the digital city: exploring generational influences among community telecentre users*. *Telematics and Informatics* 28, 204–214.
- BBC (2014) *The Switchover Help Scheme*. Available at: www.bbc.co.uk/aboutthebbc/insidethebbc/howwework/accountability/helpscheme.html?source_url=/aboutthebbc/insidethebbc/howwework/accountability/helpscheme/ (accessed 6 June 2015).
- Berry, R. (2011) *Older people and the internet: Towards a 'system map' of digital exclusion*. International Longevity Centre-UK: London. Available at: www.ilcuk.org.uk/files/pdf_pdf_181.pdf (accessed 6 June 2015).
- Blažun, H., Saranto, K. and Rissanen, S. (2012) *Impact of computer training courses on reduction of loneliness of older people in Finland and Slovenia*. *Computers in Human Behavior* 28(4), 1202–1212.
- Bobillier Chaumon, M.-E., Michel, C., Tarpin Bernard, F. and Croisile, B. (2013) *Can ICT improve the quality of life of elderly adults living in residential home care units? From actual impacts to hidden artefacts*. *Behaviour & Information Technology* 33(6), 574–590.
- Boonstra, A. and van Offenbeek, M. A. G. (2010) *Towards consistent modes of e-health implementation: structural analysis of a telecare programme's limited success*. *Information Systems Journal* 20, 537–561.
- Botsis, T. and Hartvigsen, G. (2008) *Current status and future perspective in telecare for elderly people suffering from chronic diseases*. *Journal of Telemedicine and Telecare* 14(4), 195–203.

- Brignell, M., Wooton, R. and Gray, L. (2007) *The application of telemedicine to geriatric medicine*. *Age and Ageing* 36(4), 369–374.
- Burmeister, O. K. (2010) *Websites for seniors: cognitive accessibility*. *International Journal of Emerging Technologies and Society* 8(2), 99–113.
- Cardozo, L. and Steinberg, J. (2010) *Telemedicine for recently discharged older patients*. *Telemedicine and E-Health* 16(1), 49–54.
- Carehome.co.uk (2014) *Care Homes/Nursing Homes with Internet Access in the UK*. Available at: www.carehome.co.uk/care_search_results.cfm/searchcountry/uk/searchctype/internet-access (accessed 6 June 2015).
- Carpenter, B. and Buday, S. (2007) *Computer use among older adults in a naturally occurring retirement community*. *Computers in Human Behavior* 23(6), 3012–3024.
- Cartwright, M., Hirani, S. P., Rixon, L., Beynon, M., Doll, H., Bower, P., Bardsley, M., Steventon, A., Knapp, M., Henderson, C., Rogers, A., Sanders, C., Fitzpatrick, R., Barlow, J., Newman, S. P. and the Whole Systems Demonstrator Evaluation Team (2013) *Effect of telehealth on quality of life and psychological outcomes over 12 months (Whole Systems Demonstrator telehealth questionnaire study): nested study of patient reported outcomes in a pragmatic, cluster randomised controlled trial*. *British Medical Journal* 346: f653.
- Chan, M., Campo, E., Esteve, D. and Fourniols, J.-Y. (2009) *Smart homes: current features and future perspectives*. *Maturitas* 64(2), 90–97.
- Cheek, P., Nikpour, L. and Nowlin, H. (2005) *Ageing well with smart technology*. *Nursing Administration Quarterly* 29(4), 329–338.
- Choudrie, J., Grey, S. and Tsitsianis, N. (2010) *Evaluating the digital divide: the silver surfer's perspective*. *Electronic Government: An International Journal* 7(2), 148–167.
- Communications Consumer Panel (2012) *Bridging the Gap: Sustaining Online Engagement*. Futuresight: London. Available at: [www.communicationsconsumerpanel.org.uk/downloads/what-we-do/previous-projects/internet/bridging-the-gap-sustaining-online-engagement/Bridging the gap and cover.pdf](http://www.communicationsconsumerpanel.org.uk/downloads/what-we-do/previous-projects/internet/bridging-the-gap-sustaining-online-engagement/Bridging%20the%20gap%20and%20cover.pdf) (accessed 6 June 2015).
- Copeland, E., Fink, S. and Scott, C. (2014) *Technology Manifesto*. Policy Exchange. Available at: www.policyexchange.org.uk/images/publications/technology_manifesto.pdf (accessed 6 June 2015).
- Courtin, E. and Knapp, M. (2015) *Health and wellbeing consequences of social isolation and loneliness in old age: scoping review*. NIHR School for Social Care Research: London.
- Cresci, K., Yarandi, H. and Morrell, R. (2010) *The digital divide and urban older adults*. *Computers, Informatics, Nursing* 28(2), 88–94.

- Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A. and Sharit, J. (2006) *Factors predicting the use of technology: findings from the Centre for Research and Education on Ageing and Technology Enhancement (CREATE)*. *Psychology and Aging* 21(2), 333–352.
- Damant, J. (2015) *Older adults, e-inclusion and access to ICT-based care*. PhD thesis. London School of Economics and Political Science.
- Demeris, G., Doorenbos, A. and Towle, C. (2009) *Ethical considerations regarding the use of technology for older adults*. *Research in Gerontological Nursing* 2(2), 128–136.
- Department for Business Innovation and Skills, and Department for Culture, Media and Sport (2009) *Digital Britain: Final Report*. Available at: http://books.google.com/books?hl=en&lr=&id=vo4pfi0D5Q4C&oi=fnd&pg=PA10&dq=Digital+Britain:+Final+Report&ots=6BUY4rpj0U&sig=LNWbHvV9JzotFmNI_607_cZR8NE (accessed 6 June 2015).
- Department of Health (2012) *Caring for our Future: Reforming Care and Support*. The Stationery Office: London. Available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/136422/White-Paper-Caring-for-our-future-reforming-care-and-support-PDF-1580K.pdf (accessed 6 June 2015).
- Digital Unite (2014) *About Spring Online*. Available at: <http://digitalunite.com/spring-online/about-spring-online> (accessed 6 June 2015).
- Ding, D., Cooper, R. A., Pasquina, P. F. and Fici-Pasquina, L. (2011) *Sensor technology for smart homes*. *Maturitas* 69(2), 131–136.
- Drexler, K. M. (2007) *Icons of Business: An Encyclopedia of Mavericks, Movers and Shakers*. Greenwood Publishing Group: Westport, CT.
- Dutton, W. H. and Blank, G. (2011) *Next Generation Users: The Internet in Britain*. *Oxford Internet Survey 2011 Report*. Available at: www.oii.ox.ac.uk/publications/oxis2011_report.pdf (accessed 19 June 2015).
- Dutton, W. H. and Blank, G. (2013) *Cultures of the Internet: The Internet in Britain*. *Oxford Internet Survey 2013 Report*. Available at: <http://oxis.oii.ox.ac.uk/wp-content/uploads/2014/11/OxIS-2013.pdf> (accessed 17 June 2015).
- Eastman, J. K. and Iyer, R. (2004) *The elderly's uses and attitudes towards the internet*. *Journal of Consumer Marketing* 21(3), 208–220.
- Erickson, J. and Johnson, G. M. (2011) *Internet use and psychological wellness during late adulthood*. *Canadian Journal of Aging* 30(2), 197–209.
- European Commission (2007) *Measuring Progress in E-inclusion: Riga Dashboard*. European Commission: Brussels.

- Eurostat (2014) Table [isoc_sk_iskl_i]: Individuals' level of internet skills. European Commission: Luxembourg. Available from: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_sk_iskl_i&lang=en (accessed 6 June 2015).
- Feist, H., Parker, K., Howard, N. and Hugo, G. (2010) *New technologies: their potential role in linking rural older people to community*. International Journal of Emerging Technologies 8(2), 68–84.
- Ferro, E., Helbig, N. C. and Gil-Garcia, J. R. (2011) *The role of IT literacy in defining digital divide policy needs*. Government Information Quarterly 28(1), 3–10.
- Finn, R. and Wright, D. (2011) *Mechanisms for stakeholder co-ordination in ICT and ageing*. Journal of Information, Communication and Ethics in Society 9(4), 265–286.
- Garceau, M., Vincent, C. and Robichaud, L. (2007) *Note de recherche: la télésurveillance comme outil favorisant la participation sociale des personnes âgées à domicile*. Canadian Journal on Ageing 26(1), 59–72.
- Gatto, S. L. and Tak, S. H. (2008) *Computer, internet and e-mail use among older adults: benefits and barriers*. Educational Gerontology 34(9), 800–811.
- Go ON UK (2014) *Go ON UK: Empowering everyone to reach their digital potential*. Available at: www.go-on.co.uk (accessed 6 June 2015).
- GSMArea (2010) *Mobile phone evolution: Story of shapes and sizes*. Available at: www.gsmarena.com/mobile_phone_evolution-review-493p6.php (accessed 6 June 2015).
- Haddon, L. (2000) *Social exclusion and information and communication technologies: lessons from studies of single parents and the young elderly*. New Media and Society 2(4), 387–406.
- Hardhill, I. and Olphert, C. W. (2012) *Staying connected: Exploring mobile phone use amongst older adults in the UK*. Geoforum 43(6), 1306–1312.
- Harjumaa, M. and Isomursu, M. (2012) *Field work with older users: challenges in design and evaluation of information systems*. The Electronic Journal Information Systems Evaluation 15(1), 50–62.
- Harrod, M. (2010) *"I have to keep going": Why some older adults are using the internet for health information*. Ageing International 36(2), 283–294.
- Heart, T. and Kalderon, E. (2013) *Older adults: are they ready to adopt health-related ICT?* International Journal of Medical Informatics 82(11), e209–e231.
- Helsper, E. (2008) *Digital Inclusion: An Analysis of Social Disadvantage and the Information Society*. Department for Communities and Local Government: London. Available at: www.esd.org.uk/esdtoolkit/communities/DigitalInclusion/tools%5COXiS%20Report.pdf (accessed 6 June 2015).

Henderson, C., Knapp, M., Fernandez, J.-L., Beechan, J., Hirani, S. P., Cartwright, M., Beynon, M., Rogers, A., Bower, P., Fitzpatrick, R., Steventon, A., Bardsley, M., Hendy, J. and Newman, S. P. (2013) *Cost effectiveness of telehealth for patients with long term conditions (Whole Systems Demonstrator telehealth questionnaire study): nested economic evaluation in a pragmatic, cluster randomised controlled trial*. *British Medical Journal* 346, f1035.

Henderson, C., Knapp, M., Fernandez, J.-L., Beecham, J., Hirani, S. P., Beynon, M., Cartwright, M., Rixon, L., Doll, H., Bower, P., Steventon, A., Rogers, A., Fitzpatrick, R., Barlow, J., Bardsley, M. and Newman, S. P. (2014) *Cost-effectiveness of telecare for older people with social care needs: The Whole Systems Demonstrator cluster randomised trial*. *Age and Ageing* 43(6), 794–800.

Hernandez-Encuentra, E., Pousada, M. and Gomez-Zuniga, B. (2009) *ICT and older people: beyond usability*. *Educational Gerontology* 35(3), 226–245.

Hill, R., Beyon-Davies, P. and Williams, M. D. (2008) *Older people and internet engagement*. *Information Technology and People* 21(3), 244–266.

Hirani, S., Beynon, M., Cartwright, M., Rixon, L., Doll, H., Henderson, C., Bardsley, M., Steventon, A., Knapp, M., Rogers, A., Bower, P., Sanders, C., Fitzpatrick, R., Hendy, J. and Newman, S. P. (2014) *The effect of telecare on the quality of life and psychological well-being of elderly recipients of social care over a 12-month period: the Whole Systems Demonstrator cluster randomised trial*. *Age and Ageing* 43(3), 334–341.

Huang, C. (2010) *Internet use and psychological well-being: a meta analysis*. *Cyberpsychology Behavior and Social Networking* 13(3), 241–249.

Huang, H., Apouey, B. and Andrews, J. (2014) *Racial and ethnic disparities in awareness of cancer genetic testing among online users: Internet use, health knowledge, and socio-demographic correlates*. *Journal of Consumer Health on the Internet* 18(1), 15–30.

Independent Age (2010) *Older People, Technology and Community*. Calouste Gulbenkian Foundation: London.

Karunanithi, M. (2008) *Expert review of medical devices*. *Future Drugs* 4(2), 267–277.

Koch, S. and Hägglund, M. (2009) *Health informatics and the delivery of care to older people*. *Maturitas* 63(3), 195–199.

Koopman-Boyden, P. G. and Reid, S. L. (2009) *Internet/e-mail usage and well-being among 65-84 year olds in New Zealand: policy implications*. *Educational Gerontology* 35(11), 990–1007.

Lai, C. K. Y., Chung, J. C. C., Leung, N. K. L., Wong, J. C. T. and Mak, D. P. S. (2010) *A survey of older Hong Kong people's perceptions of telecommunication technologies and telecare devices*. *Journal of Telemedicine and Telecare* 16(8), 441–446.

Lauriks, S., Reinersmann, A., van der Roest, H. G., Meiland, F. J. M., Davies, R. J., Moelaert, F., Mulvenna, M. D., Nugent, C. D. and Dröes, R. M. (2007) *Review of ICT-based services for identified unmet needs in people with dementia*. *Ageing Research Reviews* 6(3), 223–246.

- Leora, J. A. (2008) *Generational differences in acceptance of technology*. *Telemedicine and E-Health* 14(10), 1087–1090.
- Leppel, K. and McCloskey, D. W. (2011) *A cross-generational examination of electronic commerce adoption*. *Journal of Consumer Marketing* 28(4), 261–268.
- Lewin, D., Adshead, S., Glennon, B., Williamson, B. and Moore, T. (2010) *Assisted living technologies for older and disabled people in 2030*. Plum Consulting: London. Available at: www.plumconsulting.co.uk/pdfs/Plum_June2010_Assisted_living_technologies_for_older_and_disabled_people_in_2030.pdf (accessed 17 June 2015).
- Littlechild, S. A. and Barr, L. (2013) *Using the internet for information about breast cancer: a questionnaire-based study*. *Patient Education and Counseling* 92, 413–417.
- Lloyd, L. (2010) *The individual in social care: the ethics of care and the “personalisation agenda” in services for older people in England*. *Ethics and Social Welfare* 4(2), 188–200.
- Ludwig, W., Wolf, K.-H., Duwenkamp, C., Gusew, N., Hellrun, N., Marschollek, M., Wagner, M. and Haux, R. (2012) *Health-enabling technologies for the elderly: an overview of services based on a literature review*. *Computer Methods and Programs in Biomedicine* 106(2), 70–78.
- Mahony, E. L. and Mahony, D. F. (2010) *Acceptance of wearable technology by people with Alzheimer’s Disease: issues and accommodations*. *American Journal of Alzheimer’s Disease and Other Dementias* 25(6), 527–531.
- Marquié, J. C., Jourdan-Boddaert, L. and Huet, N. (2002) *Do older adults underestimate their actual computer knowledge*. *Behaviour and Information Technology* 21(4), 273–280.
- Martinez-Pecino, R., Lera, M. J. and Martinez-Pecino, M. (2012) *Active seniors and mobile phone interaction*. *Social Behaviour and Personality* 40(5), 875–880.
- Mason, M., Sinclair, D. and Berry, C. (2012) *Nudge or Compel? Can Behavioural Economics Tackle the Digital Exclusion of Older People?* International Longevity Centre-UK: London.
- Matthews, J. T., Beach, S. R., Downs, J., Bruine de Bruin, W. and Mecca, L. P. (2010) *Preferences and concerns for quality of life technology among older adults and persons with disabilities: National survey results*. *Technology and Disability* 22, 5–15.
- McMurtrey, M. E., Downey, J. P., Zeltmann, S. M. and McGaughey, R. E. (2011) *Seniors and technology: results from a field study*. *The Journal of Computer Information Systems* 51(4), 22–30.
- Mertens, A., Hurtmanns, J., Wacharamanotham, C., Kronenbueger, M., Borchers, J. and Schliek, C. M. (2012) *Swabbing: touchscreen-based input technique for people with hand tremor*. *Work* 41(Suppl. 1), 2405–2411.
- Milligan, C., Roberts, C. and Mort, M. (2011) *Telecare and older people: who cares where?* *Social Science & Medicine* 72(3), 347–354.

Morris, A., Goodman, J. and Brading, H. (2007) *Internet use and non-use: views of older users*. *Universal Access in the Information Society* 6(1), 43–57.

Mukherjee, D. (2011) *Participation of older adults in virtual volunteering: a qualitative analysis*. *Ageing International* 36(2), 253–266.

Nijland, N., van Gemert-Pijnen, J. E. W. C., Boer, H., Steehouder, M. F. and Seydel, E. R. (2009) *Increasing the use of e-consultation in primary care: results of an online survey among non-users of e-consultation*. *International Journal of Medical Informatics* 78(10), 688–703.

Ofcom (2011) *Communications Market Report: UK*. Ofcom: London. Available at: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr11/UK_CM_2011_FINAL.pdf (accessed 6 June 2015).

Ofcom (2012) *Communications Market Report 2012*. Ofcom: London. Available at: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf (accessed 6 June 2015).

Ofcom (2013a) *UK Fixed Broadband Map 2013*. Available at: <http://maps.ofcom.org.uk/broadband> (accessed 19 June 2015).

Ofcom (2013b) *Communications Market Report 2013*. Ofcom: London. Available at: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/2013_UK_CM.pdf (accessed 6 June 2015).

Ofcom (2014) *Adults' media use and attitudes report*. Ofcom: London. Available at: http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/media-lit-10years/2015_Adults_media_use_and_attitudes_report.pdf (accessed 6 June 2015).

Office for National Statistics (2013) *2011 Census, Population Estimates by five-year age bands, and Household Estimates, for Local Authorities in the United Kingdom*. Available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-294273 (accessed 6 June 2015).

Office for National Statistics (2014a) *Internet Access – Households and Individuals, 2014*. Available at: www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-322080 (accessed 6 June 2015).

Office for National Statistics (2014b) *2011 Census Analysis, Households and Household Composition in England and Wales, 2001-2011*. Available at: www.ons.gov.uk/ons/rel/census/2011-census-analysis/households-and-household-composition-in-england-and-wales-2001-2011/index.html (accessed 6 June 2015).

Olphert, W. and Damodaran, L. (2013) *Older people and digital disengagement: a fourth digital divide*. *Gerontology* 59, 564–570.

Olson, K. E., Brien, M. A. O., Rogers, W. A. and Charness, N. (2011) *Diffusion of technology : frequency of use for younger and older adults*. *Ageing International* 36(1), 123–145.

- O'Neill, S. (2009) *Falling PC Prices Pit Microsoft Against PC Makers*. Available at: www.itworld.com/article/2766126/hardware/falling-pc-prices-pit-microsoft-against-pc-makers.html (accessed 6 June 2015).
- Paul, G. and Stegbauer, C. (2005) *Is the digital divide between young and elderly people increasing?* *First Monday*, 10(10). Available at: <http://journals.uic.edu/ojs/index.php/fm/article/view/1286/1206> (accessed 17 June 2015).
- Plaza, I., Martín, L., Martín, S. and Medrano, C. (2011) *Mobile applications in an aging society: Status and trends*. *The Journal of Systems & Software* 84(11), 1977–1988.
- Price, A. (2011) *Internet guide for older people and their physicians*. *Geriatric Medicine* 41(7), 356–359.
- Ragoobar, T., Whalley, J. and Harle, D. (2011) *Public and private intervention for next-generation access deployment: Possibilities for three European countries*. *Telecommunications Policy* 35(9-10), 827–841.
- Randall, C. (2010) *Social Trends 41: E-Society*. Office for National Statistics: Newport.
- Roberts, S. (2009) *The Fictions, Facts and Future of Older People and Technology*. International Longevity Centre-UK: London.
- Robertson-Lang, L., Major, S. and Hemming, H. (2011) *An exploration of search patterns and credibility issues among older adults seeing online health information*. *Canadian Journal on Ageing* 30(4), 631–645.
- Sadri, F. (2011) *Ambient intelligence*. *ACM Computing Surveys* 43(4), 1–66.
- Sanders, C., Rogers, A., Bowen, R., Bower, P., Hirani, S., Cartwright, M., Fitzpatrick, R., Knapp, M., Barlow, J., Hendy, J., Chrysanthaki, T., Bardsley, M. and Newman, S. P. (2012) *Exploring barriers to participation and adoption of telehealth and telecare within the Whole Systems Demonstrator trial: a qualitative study*. *BMC Health Services Research* 12, 220–231.
- Sayago, S. and Blat, J. (2010) *Telling the story of older people e-mailing: an ethnographical study*. *International Journal of Human-Computer Studies* 68(1-2), 105–120.
- Seale, C., Ziebland, S. and Charteris-Black, J. (2006) *Gender, cancer experience and internet use: A comparative keyword analysis of interviews and online cancer support groups*. *Social Science & Medicine* 62, 2577–2590.
- Selwyn, N. (2004) *The information aged: A qualitative study of older adults' use of information and communications technology*. *Journal of Ageing Studies* 18(4), 369–384.
- Selwyn, N., Gorard, S., Furlong, J. and Madden, L. (2003) *Older adults' use of information and communications technology in everyday life*. *Ageing and Society* 23(5), 561–582.
- Sinclair, D. (2010) *Technology and Care*. International Longevity Centre-UK: London.

- Singh, H., Fox, S. H., Petersen, N. J., Shethia, A. and Street, R. L. (2009) *Older patients' enthusiasm to use electronic mail to communicate with their physicians: cross-sectional survey*. *Journal of Medical Internet Research* 11(2), e18.
- Sixsmith, A. and Sixsmith, J. (2008) *Ageing in place in the United Kingdom*. *Ageing International* 32(3), 219–235.
- Slegers, K., van Boxtel, M. P. J. and Jolles, J. (2008) *Effects of computer training and internet usage on the well-being and quality of life of older adults: a randomized, controlled study*. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences* 63(3), P176–184.
- Slevin, J. (2000) *The Internet and Society*. Cambridge: Polity Press.
- Sourbati, M. (2011) *The digital switchover as an information society initiative: the role of public policy in promoting access to digital ICTs*. *Telematics and Informatics* 28(4), 295–302.
- Stellefson, M., Chaney, B. and Chaney, D. (2008) *The digital divide in health education: myth or reality?* *American Journal of Health Education* 39(2), 106–112.
- Steventon, A., Bardsley, M. and Billings, J. (2012) *Effect of telehealth on use of secondary care and mortality: findings from the Whole System Demonstrator cluster randomised trial*. *British Medical Journal* 3874(June), 1–15.
- Stroud, D. (2011) *Connecting with older consumers*. *Market Leader*, Quarter 1, 42–46.
- Stroud, D. (2012) *The digitally excluded consumer: options for marketers*. *Journal of Direct, Data and Digital Marketing Practice* 14(1), 5–17.
- Sum, S., Mathews, M., Hughes, I. and Campbell, A. (2008) *Internet use and loneliness in older adults*. *Cyberpsychology Behavior and Social Networking* 11(2), 208–211.
- Sus-IT project (2011) *Sus-IT: A New Dynamics of Ageing Project*. Available at: www.newdynamics.group.shef.ac.uk/sus-it.html (accessed 17 June 2015).
- Tak, S. H., Benefield, L. E. and Mahoney, D. F. (2010) *Technology for long-term care*. *Research in Gerontological Nursing* 3(1), 61–72.
- Takahashi, Y., Ohura, T., Ishizaki, T., Okamoto, S., Miki, K., Naito, M., Akamatsu, R., Sugimori, H., Yoshiike, N., Miyaki, K., Shimbo, T. and Nakayama, T. (2011) *Internet use for health-related information via personal computers and cell phones in Japan: a cross-sectional population-based survey*. *Journal of Medical Internet Research* 13(4), e110.
- Technology Services Association (2013) *Telecare and Telehealth: The Technology Behind the Service*. Available at: www.telecare.org.uk/consumer-services/telecare-and-telehealth (accessed 6 June 2015).
- The Personal Computer (2014) Available at: www.historylearningsite.co.uk/personal_computer.htm (accessed 6 June 2015).

Timmers, P. (2008) *EU e-inclusion policy in context*. Info 10(5), 12–19.

Top Ten Countries with Highest Number of PCs (2013) Available at:
www.mapsofworld.com/world-top-ten/world-top-ten-personal-computers-users-map.html
(accessed 6 June 2015).

Tsai, H., Tsai, Y., Wang, H., Chang, Y. and Hua, H. (2010) *Videoconference program enhances social support, loneliness, and depressive status of elderly nursing home residents*. Ageing and Mental Health 14(8), 947–954.

Tse, M. M. Y., Choi, K. C. Y. and Leung, R. S. W. (2008) *E-health for older people: the use of technology in health promotion*. Cyberpsychology Behavior and Social Networking 11(4), 475–479.

Turgeon-Londei, S., Rousseau, J., Ducharmel, F., St-Arnaud, A., Meunier, J., Saint-Arnaud, J. and Giroux, F. (2009) *An intelligent videomonitoring system for fall detection at home: perceptions of elderly people*. Journal of Telemedicine and Telecare 15(8), 383–390.

UK Online Centres (2014) *Older People Specialist Network*. Available at:
www.ukonlinecentres.com/about-us/our-network/older-people-specialist-network (accessed 6 June 2015).

Van Deursen, A. J. A. and van Dijk, J. A. G. M. (2011) *Internet skills and the digital divide*. New Media and Society 13(6), 893–911.

Van Isacker, K., Goranova-Valkova, M., Leuteritz, J.-P. and Melcher, V. (2010) *Assessing the accessibility of UI for all ages*. In: Cunningham, P. and Cunningham, M. (eds), *IST-Africa*. International Information Management Corporation: Durban, South Africa.

Vicente, M. R. and Lopez, A. J. (2011) *Assessing the regional digital divide across the European Union-27*. Telecommunications Policy 35(3), 220–237.

Vodafone Limited (2014) *Thirtieth anniversary of first UK mobile phone call*. Available at:
www.vodafone.com/content/index/media/vodafone-group-releases/2014/thirtieth_anniversary_uk_mobile_call.html (accessed 6 June 2015).

Wagner, F., Basran, J. and Dal Bello-Haas, V. (2012) *A review of monitoring technology for use with older adults*. Journal of Geriatric Physical Therapy 35(1), 28–34.

Wagner, N., Hassanein, K. and Head, M. (2010) *Computer use by older adults: A multi-disciplinary review*. Computers in Human Behavior 26, 870–882.

Walsh, K. and Callan, A. (2011) *Perceptions, preferences and acceptance of information and communication technologies in older-adult community care settings in Ireland: a care-study and ranked-care program analysis*. Ageing International 36(1), 102–122.

Weaver, C. K., Zorn, T. and Richardson, M. (2010) *Goods not wanted*. Information, Communication & Society 13(5), 696–721.

Williams, V., McCrindle, R. and Victor, C. (2010) *Older people's perceptions of assistive technology: an exploratory pan-European study*. *Journal of Integrated Care* 18(1), 38–44.

Withers, P. (2014) *Smartphone prices forecasted to fall to £180 average this year*. Available at: www.mobilenewscwp.co.uk/2014/01/07/smartphone-prices-forecasted-to-fall-to-average-of-180-this-year (accessed 6 June 2015).

Wong, A. M. K., Chang, W.-H., Ke, P.-C., Huang, C.-K., Tsai, T.-H., Chang, H.-T., Shieh, W.-Y., Chan, H.-L., Chen, C.-K. and Pei, Y.-C. (2012) *Technology acceptance for an Intelligent Comprehensive Interactive Care (ICIC) System for Care of the elderly: a survey- questionnaire study*. *PLoS One* 7(8), e40591.

Woodward, A. T., Freddolino, P. P., Blaschke-Thompson, C. M., Wishart, D. J., Bakk, L., Kobayashi, R. and Caitlin, T. (2011) *Technology and aging project: training outcomes and efficacy from a randomized field trial*. *Ageing International* 36(1), 46–65.

Wright, D. and Wadhwa, K. (2010) *Mainstreaming the e-excluded in Europe: strategies, good practices and some ethical issues*. *Ethics and Information Technology* 12, 139–156.

Xie, B. (2003) *Older adults, computers, and the internet: future directions*. *Gerontechnology* 2(4), 289–305.

Zweijssen, S. A., Niemeijer, A. R. and Hertogh, C. M. P. (2011) *Ethics of using assistive technology in the care for community-dwelling elderly people: An overview of the literature*. *Ageing and Mental Health* 15(4), 419–427.



© Crown copyright 2015

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gsi.gov.uk.

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

This publication available from www.gov.uk/go-science

Contacts us if you have any enquiries about this publication, including requests for alternative formats, at:

Government Office for Science
1 Victoria Street
London SW1H 0ET
Tel: 020 7215 5000
Email: contact@go-science.gsi.gov.uk

GS/15/6