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Technology and Social Care in a Digital World: Challenges and Opportunities in the UK

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Abstract:

Purpose: Technology enabled care (TEC) equipment has been a part of adult social care (ASC) in most areas of the UK for decades. More recently commissioners have been exploring mainstream technologies' potential to support older people living in the community. This general review paper examines the challenges and opportunities presented by the growing application of mainstream technologies in ASC against the backdrop of the planned UK-wide switchover from analogue to digital telecommunications by 2025.

Approach: This general review uses research evidence, literature, industry standards and policy documents to address the challenges presented by the UK's digital switchover and the potential role of mainstream technologies such as 'smart speakers' in ASC.

Findings: The use of digital TEC and mainstream devices in ASC bring challenges related to 1) access to reliable internet connections in parts of the UK; 2) the need to update TEC safety standards; 3) the ethics, privacy and data security measures that ensure digital products and services safeguard the interests of users; and 4) evidence and commissioning practice.

Originality/value: This general review explores emerging areas of policy and research related to the planned UK digital switchover and the use of mainstream technologies in ASC. It offers a conceptual approach and suggests ways forward for research, regulatory and commissioning agendas.

Introduction

This paper offers a general review of a nascent area in UK adult social care (ASC) policy and practice: the commissioning of mainstream technologies. This burgeoning phenomenon has been influenced in part by the increasing prevalence and fast-paced development of devices such as voice-activated 'smart speakers'. It is also a by-product of the ongoing decommissioning of existing analogue-based technology enabled care services (TECS), ahead

of the planned switch to digital telecommunications networks by 2025. The evidence and literature on TECS and mainstream technologies, industry standards, and the policy documents of national and local governments, and TECS and telecommunications regulators have been examined to explore some of the challenges and opportunities presented by this digital shift and the growing application of mainstream technologies in ASC in the UK.

Technology and ASC in the UK

In the UK, responsibility for policy, legislation, standards and the allocation of funding in ASC is devolved to the four nations, and the delivery of services is the responsibility of multiple local councils; 152 in England, 22 in Wales, 32 in Scotland and in Norther Ireland five 'health and social care trusts' (Gray & Birrell, 2013). UK ASC services face significant challenges in the 2020s, including a mismatch between supply and demand for care arising from population ageing and the changing nature of care needs (including increasing co-morbid and chronic conditions). Geography also poses challenges for the design and delivery of ASC, with greater dispersal of familial networks and increasingly aged rural populations. Rising numbers of older adults live alone, often experiencing loneliness and associated negative wellbeing and health outcomes, and growing numbers of older people have no children who can support them. In the past decade, ASC has experienced substantial cuts in funding, especially in England, with some local authorities struggling to deliver the wellbeing outcomes envisaged in the *Care Act 2014* (Hamblin, 20209; forthcoming).

Technology has been identified as a means of addressing what some call the UK's 'crisis of social care' and delivering good quality care in the future (HM Government, 2010; Carers UK, 2012; LGA, 2016; TSA, 2017). Since 1998 there have been over 25 UK government and official reports advocating the use of technology in care, and between 2006-2012 over £160m of public funding was allocated to initiatives intended to support its uptake (Barlow et al., 2012a). There is no statutory requirement to provide technology as part of local authority ASC in the UK, however, and development of local provision has been uneven. Technology in some form has nevertheless been part of UK ASC arrangements for older adults since the 1960s, starting with 'pull cord' monitoring devices in sheltered accommodation schemes (Fisk, 2003). Historically, technology in ASC was referred to as 'telecare'; later the term 'technology enabled care services' was introduced, with telecare a subset of a broader range of devices that also include telemedicine and telehealth devices (NHS, 2015).

The shift to digital and mainstream technologies

Until recently, most local authority-commissioned TECS in the UK focused on what the literature (Doherty et al., 1996) and policy and practice documents (e.g. JIT Scotland, 2010) termed 'first' and 'second generation' telecare. The 'first generation' include personal alarms that enable a user to summon help by pulling a cord or pressing an alarm button; 'second generation' devices include continuous environmental monitoring equipment with sensors that use algorithms to raise an alarm in an emergency. The 'third generation' uses broadband and wireless technology to connect users to a 'virtual neighbourhood' including health and social

care professionals and recreational and social activities, which some commissioners are exploring in through use of mainstream and 'internet of things' (IoT) devices. In 2017, it was estimated that over 1.7 million people in the UK had TECS in their own homes; by 2020 it is thought 20-30 billion IoT devices will be in use globally (TSA, 2017). As a result, the national TEC Services Association (TSA) highlighted in its 2017 'White Paper' the increasing role of mainstream IoT devices within TECS packages.

One factor driving interest in digital solutions in the UK is the planned nationwide switchover from analogue 'voice-band signalling' to digital packet-switched internet protocol solutions by 2025 (in some areas as early as 2023). Historically, UK landline telephone services were delivered through copper wires over the public-switched telephone network (PSTN). To reduce maintenance costs, providers are moving services to modern internet protocol-based (IP) networks. Other nations have made or are making similar changes (OfCom, 2019b). In the UK, most existing telecare devices use a short-range radio frequency link from a pendant alarm or other device to connect a base unit which alerts one of 240+ alarm receiving centres (ARCs) via a fixed line or GSM dial-up service (TSA, 2011). As the switchover occurs, any TEC devices using fixed line services will need to be replaced by digital alternatives to ensure reliable connectivity via IP networks (Cruickshank & Trim, 2019). Falkirk Council's experience (in Scotland) highlights the importance of upgrading existing analogue equipment to devices which can connect via IP networks. In just one month after the telecommunications provider switched to IP networks, 1,200 TECS calls failed to reach the ARC or had poor sound quality (TSA, 2017).

For many TEC product manufacturers, the focus has been on adapting existing analogue equipment to use a SIM or GSM dial-up service via an Ethernet cable. Large-scale upgrading programmes at local authority level have been slow to emerge and it is estimated that replacing existing analogue TECS devices with digital versions requires investment of some £150-£300 million (TSA, 2017). Liverpool City Council for example, estimates that (excluding new service users) to transfer its existing 4,000 analogue TECS users to digital alternatives (SIM-enabled devices) would cost £234,000 (Williams & Kay, 2018). As an interim measure, some telecommunications providers offer an Analogue Telephony Adapter port when installing broadband to keep analogue devices functioning until they can be upgraded, but providers have not guaranteed this provision in the longer term (TSA, 2020).

In some localities the switchover has been a catalyst for innovation; several have launched trials or pilots of digital devices, including mainstream products (e.g. Sunderland, Oxfordshire and Hampshire have deployed Amazon's Alexa product). 'Mainstream' technologies, such as voice-activated devices or 'smart speakers' (Amazon's Alexa; Google's Assistant) and IoT solutions (Centrica's Hive), are becoming attractive to ASC commissioners as a way of delivering some services (Consilium Research & Consultancy, 2018; Cruickshank and Trim, 2019; TSA, 2017). They are accessible and affordable to the public; an estimated one fifth of UK households now have smart speakers (CDEI, 2019). This innovation brings challenges, raising issues of ethics, data ownership and management, and accessibility, infrastructure and local contexts. The following sections explore these challenges, and potential ways forward for practice, regulation and research.

Challenges

The digital divide

The first challenge in delivering digital TECS and mainstream technologies in ASC is the 'digital divide', or inequality of access to the internet (Stern, 2010), influenced both by user characteristics and infrastructural differences. Digital TECS and mainstream devices both require broadband or 3/4/5G infrastructures to function securely and reliably. The market-led approach to modernising internet infrastructures adopted by UK governments (DBIS & DCMS, 2009) has led to geographical disparities in 'next generation access' (NGA) internet networks (Damant and Knapp, 2015). The initial roll-out of fibre-optic broadband focused on highly populated, affluent areas to secure a return on investment for private companies (Ferro et al., 2011), and variation in connectivity results has led to "*unacceptable inequalities",* with some groups excluded from digital TECS (TSA, 2017: 15).

Levels of internet access in the UK have been rising steadily – in 2019 about 90% of households in Great Britain had access, while the remaining 5.3 million adults had not used the internet in the previous three months (ONS, 2019) – but access to, and use of the internet varies geographically. In England, the highest proportion of non-users are in the North-East and Yorkshire and the Humber regions (ONS, 2019) and in some local authorities accessing reliable, high-quality broadband connections is problematic. Thus in Kingston-Upon-Hull, only 36% of premises had NGA availability, compared with 100% of premises in Worthing, Thanet and Crawley (OfCom, 2017). There are also areas (Ryedale, West Devon and Torridge) where 6-7% of premises cannot access the internet with a speed of 2Mbits (the minimum required to operate devices such as smart speakers). Access to a reliable 4G signal also varies; 19.5% of premises in Herefordshire, for example, could not receive a reliable 4G signal, and in Rutland 53.5% of households could only receive 4G signal from one operator (OfCom, 2017). In these areas, it is problematic for manufacturers and local authorities to offer SIM-enabled TECS as an alternative to analogue devices in homes without a broadband connection.

Non-use of the internet is also associated with personal characteristics, including age.[1] Consistently adults over 65 years old have made up the largest proportion of internet non-users; in 2018, over half of all non-users were aged over 75 (ONS, 2019). Ownership of any internet-enabled devices is also lower in this age group than any other (ONS, 2018). ASC commissioners hoping to provide digital TEC solutions for their older service users thus face challenges both the availability of reliable networks and in the lower levels of existing internet connections and digital devices this group can access. These issues are particularly important in areas of the UK where populations are older *and* access to reliable connections is poor; local authorities in Devon, Somerset, Norfolk and Dorset all have high proportions of their populations aged over 65 and low internet connectivity.[2]

[1] Income and disability are other factors that influence access to the internet and digital devices (OfCom, 2019a).

[2] In addition to having the UK's most aged populations, in 2016, these areas were among the 10 with: the highest percentage of premises unable to access 2Mbit/s of internet (Somerset, Devon); no reliable

Safety standards and frameworks

The use of digital TEC and mainstream technologies in ASC raises other issues too. Product standards and regulations are often set initially at individual company level as part of quality assurance processes. In turn individual businesses may also develop public standards with other companies and professional bodies to promote consumer confidence. These standards may become legal requirements for all manufacturers through national, European or international directives published by organisations such as the British Standards Institute (BSI), European Committee for Electro-technical Standardization (CENELEC) and International Standards Organisation (ISO). Some professional or trade organisations develop their own standards or codes of practice, as in the TSA and the Community Equipment Code of Practice Scheme (CECOPS) (Baxter et al., 2004). UK national industry standards (BS EN50134 Alarm systems: Social alarm systems[3]) were developed based on the European EN50134 series of standards for social alarms and include features such as back-up dialling and batteries, fault identification and privacy[4], with new sections being prepared to address the shift to IP networks.[5] Systems that do not comply with EN50134 cannot be sold as 'alarm systems' in the UK, and the TSA uses these standards as the basis of its Quality Standards Framework.

There have been debates among standards and lobbying organisations, including the TSA, telecommunications providers and the communications regulator OfCom, about telecommunications standards which affect the functionality of TECS and user safety (OfCom, 2018). Traditional landline call services delivered via the PSTN are powered by a local telephone exchange and can make calls when the power supply to a premises is interrupted. With the digital switchover, calls made using voice over internet protocol (VoIP) broadband require mains power and will not work during a power cut without special battery backup systems. While pre-existing TEC standards specify 24-hour battery back-up, OfCom's general conditions (GCA3.2[b]) stipulate one hour, with the caveat *"Providers should take appropriate steps to ensure that the needs of consumers requiring additional protection, and who depend on 999/112* [emergency services] *to a greater extent than the majority of the population, are addressed*" (2018: 23). OfCom also did not include ARCs as an 'emergency organisation'[6] and therefore they cannot compel telecommunications providers to safeguard connectivity to these centres in a power cut (OfCom, 2018). Telecommunications providers supply 'protection solutions' (a free back-up service and the Priority Fault Repair register) for 'special service

4G signal (Somerset, Norfolk, Dorset, Devon); and the lowest proportion of NGA availability (Devon) (author's analysis of Ofcom, 2017).

[3] Defined as *"system providing 24 hour facilities for alarm triggering, identification, signal transmission, alarm reception, 2-way speech communication, reassurance and assistance, for use by persons who can be considered to be living at home at risk"* (BS EN 50134-1-2002, p. 5).

[4] Other regulations include: BS EN50136-1- Alarm systems- Alarm transmission systems and equipment, BS EN50518- European Standard for Monitoring and Alarm Receiving Centres.

[5] In 2018 a protocol was added (Part 9) for communications between TEC devices and ARCs using IP. BS 8521-2 (Social alarm systems- IP signalling protocols) is currently under consultation.

[6] Included are police, fire, ambulance and coastguard services.

users' reliant on landlines but OfCom did not consider having a TEC device in the home to be an indicator that a telecommunications customer should be automatically eligible for these.

In addition to these issues related to digital TECs, there are also challenges related to the commissioning and use of mainstream technologies in ASC settings. Though there is interest amongst commissioners in smart speakers and voice assistants, caution is needed if using these products to replace TECS such as pendant alarms. Smart speakers are not marketed as social alarms, and thus are not subject to the same standards which specify: *"Failure in the operation of a social alarm system or any of its parts may compromise the ability to provide timely reassurance and assistance which may lead to a risk to a user's life. The trigger device is a part of the system and should be designed to ensure reliability beyond that of a normal consumer device"* (BS EN50134-2: 2017: 6). This raises the question of what standards should be in place when mainstream, consumer devices are used in care settings to summon assistance. 'Off-the-shelf' voice-controlled mainstream technologies, such as Amazon's Alexa and Google Assistant, do not follow TEC industry protocols on communication of information to an ARC. Voice assistants or smart speakers typically require users to say a particular 'wake' word; when a command is issued, the device uses natural language processing to decipher what has been said and respond. They can be configured to contact particular people, as with TEC devices, but unlike TECS, there are currently no 'fail safe' ARCs connected to provide back-up should the smart speaker fail to make contact in an emergency.

Ethics, privacy and data security

Ethical considerations, especially informed consent and choice for users, have been the focus of research on 'traditional' TECS (Zwijsen et al., 2011; Godwin, 2012), and when delivered in ASC settings, mainstream technologies such as smart speakers also raise privacy and security issues. There is a voluntary Code of Practice (DCMS, 2018)[7] in the UK for manufacturers of IoT products, based on reviews of international security measures and industry recommendations (Tanczer et al., 2018), and EU data protection laws. The Code highlights that many devices currently available lack basic security measures and research calls for greater government intervention in this area (Blythe et al., 2019; Lau et al., 2018); in response, a government consultation was launched in 2019 on IoT device regulation with a view to introducing a labelling scheme for Code-compliant products, and potentially further regulation.

In the meantime, IoT devices such as smart speakers are being trialled in numerous local authorities, for example, to issue users with reminders and control their environment (e.g. lighting, music). The use of these devices raises concerns as several studies and reports have highlighted limited public awareness of how they process and store data (Blythe et al., 2019; Malkin et al., 2019; Lau et al., 2018), including how they routinely upload to the Cloud and process voice recordings via human review to improve their functionality. These recordings can be when the device wrongly detects the 'wake word', therefore when the user had not

[7] The European Telecommunications Standards Institute (ETSI) took this Code forward to create a globally-applicable industry standard for IoT consumer devices (ETSI 103 645 Technical Standard), which was *"outcome-focused, rather than prescriptive, giving organizations the flexibility to innovate and implement security solutions appropriate for their products"* (ETSI, 2019: 5).

intended to activate the device or while unaware. Concerns in the media about manufacturers' reluctance to explain how data collected by smart speakers are processed has led to some changes in company policy, with Amazon allowing users to disable the human review of their voice recordings, while Apple and Google no longer conduct human reviews in Europe. The relationship between recordings and profiling users for advertising purposes is unclear, however, as is whether by deleting their own interaction logs users also delete any derived data (CDEI, 2019). Other concerns include the sharing of data derived from apps of 'skills' with the third parties responsible for these functions, as it is not always transparent with whom data are shared, beyond the smart speaker manufacturer, and how these data can be controlled (CDEI, 2019; Blythe et al., 2019). These devices are advocated as easy-to-use ways of connecting people who are otherwise digitally disenfranchised but the CDEI (2019) argues these may be precisely the people who are inexperienced users of technology and lack full understanding of how their data are gathered and processed, including transcription and interpretation by humans.[8] Despite the EU's General Data Protection Regulation (GDPR) requirements that information is provided in concise and digestible formats, consent forms for smart speakers are long and complex (CDEI, 2019) and publicly available information sparse (Blythe et al., 2019). Thus while there may be benefits in using smart speakers in ASC settings, users need to be aware of issues related to the data they gather; arguably local authorities providing devices to ASC users are responsible for supplying this information.

Other ethical considerations relate to the manufacture of these products and the use of public funding to invest in them. Concerns have been raised about working conditions and practices in the manufacture of Amazon's Echo devices (Chamberlain, 2019) which are pertinent as local authorities must *"identify and manage risks in both existing contracts and new procurement activity"* to comply with guidance on modern slavery (Cabinet Office, 2019). In addition, Google's and Amazon's relationship with the UK's corporation taxation system (Murphy, 2013; Addison and Mueller, 2015) raises questions about use of public funds to purchase devices from these organisations.

There are emerging ASC-specific responses to these concerns, including Scottish Care's *'Human Rights Charter for Technology and Digital in Social Care'* (2019) and the Department for Health and Social Care's (DHSC) '*Code of Conduct for Data-Driven Health and Care Technology*' (2019). The latter comprises 10 principles, including that health and social care providers should *"Use data that is in line with appropriate guidelines for the purpose for which it is being used"* (DHSC, 2019). Scottish Care, an independent body representing care providers, includes in its 17 principles that technology used in care contexts *"should be accessible, understandable and transparent"* and *"use data in a manner which respects privacy, transparency and accountability to the individual"* (p. 1). These frameworks highlight the importance of data security and privacy; the challenge for ASC commissioners will be complying with the code they select when commissioning mainstream technology where ownership of data may lie with a third party.

[8] Research has highlighted misconceptions about the storage of data collected by smart speakers (Malkin et al., 2019; Lau et al., 2018).

Evidence and outcomes-based commissioning

A further challenge is that the evidence base on mainstream technology and its role in ASC is still emerging. Without research, there is a risk of 'pro-innovation bias'[9] in practice. While many local authorities have developed small-scale pilots, there is limited focus on sustainability, scale or spread, and 'pilot fatigue' or 'pilot-itis' has been identified in relation to technology use in ASC generally (Barlow & Hendy, 2009; Barlow et al., 2012a, b); it therefore remains unclear if these devices can deliver the outcomes required in diverse local ASC contexts with different demands and policy legacies. Robust research on the impact of mainstream technologies focused on, and engaging with, users is needed to explore outcomes (beyond financial savings), and the contextual factors that influence these (Hamblin et al., 2017). Research and conceptual work related to telecare, and technology use more broadly, can provide valuable lessons for future research examining mainstream technologies' impact in ASC settings. Previous research[10] brought together insights from science and technology studies (STS), domestication (Akrich, 1992) and biographical approaches to show that technology cannot be studied in isolation from the social context in which it is situated. Technology both shapes (as it makes some things possible or impossible) and is shaped by (humans engage with, disable and enable its functions) context and interactions, and how users 'tame' (Haddon, 2006) devices is mediated by their own life histories (Greenhalgh & Swinglehurst, 2011). Moreover, technologies, including mainstream devices commissioned in ASC, cannot be assumed to be *"inherently useful and desirable"* (Selwyn, 2004: 281) with predictable outcomes for users (Xie, 2003); research can assist commissioners in disentangling these issues and informing decisions and practice. However, an additional challenge relates to the relationship between research evidence and commissioning decisions. A study of English local authority TECS commissioners found the results of the Whole System Demonstrator study (the largest randomised control trial of telecare and telehealth conducted to date), which reported modest outcomes for telecare[11], did not influence their decision-making processes; indeed, only a third of commissioners surveyed reported research evidence informed their commissioning decisions (Woolham et al., 2018).

The digital switchover presents commissioners with the opportunity to redesign TECS services influenced based on research evidence and aligned to the outcomes users wish to achieve. As aforementioned, however, digital versions of the existing analogue equipment are costly, and smart speakers do not, as yet, adhere to the communications protocols of social alarm services; it thus seems unlikely they can replace these services in a 'like-for-like' manner. This could prove beneficial, however, as research on TECS has shown that first and second generation telecare services were often not designed to meet users' desired aspirations and outcomes, instead focusing on reducing costs and demands on care workers' time, or were commissioned with technology as the starting point (Lynch et al., 2019; Toms et al., 2019; Hamblin et al.,

[9] The assumption that innovation is always 'good', without reference to actual outcomes (Seelos & Mair, 2012)

[10] For example, the ATHENE (Wherton et al., 2012) and AKTIVE (Hamblin et al., 2017; Hamblin, 2017) projects.

[11] There were no statistically significant differences between the intervention and control groups in admissions to residential care or hospital (Steventon et al., 2013), and the impact of telecare on the quality of life of users and their carers was described as 'enhancing' rather than 'transformative' (Hirani et al., 2014).

2017).[12] The need to decommission existing TECS could provide an opportunity to place users' desired outcomes at the forefront of service design, an issue highlighted in the codes of practice produced by DHSC (2019) and Scottish Care (2019) which include both user-centred design and outcomes-based commissioning.

Conclusion and ways forward

Technology has consistently been presented as a means to address the UK's 'social care crisis' but its application in ASC is not without challenges. This paper is the first, to our knowledge, to connect the impending digital switchover – a particularly pressing concern as soon analogue services will no longer function reliably – with this broader context. It has argued that alternative digital TEC options that will be required involve a range of complexities (including the uneven reliability of internet connections in parts of the UK) and raised questions about how far digital devices can meet existing TECS standards.

It has also noted alongside the shift to digital devices, a growing interest within the ASC sector in using mainstream technologies, especially the 'smart speakers' that are creating a new set of challenges for policy- and decision-makers. Mainstream technology is advancing at a rapid rate – certainly in comparison with traditional TEC devices – and offers opportunities to enhance ASC delivery in the UK and elsewhere. Yet to date, how far these devices can replicate the functionality of TEC services has not been adequately considered. Like digital TEC equipment, mainstream devices face the 'digital divide' in accessing reliable broadband and 4G/5G networks. Establishing how these technologies in care settings will operate alongside TEC devices and services with their own regulations, frameworks and protocols to ensure safety, data security and privacy will be crucial. Use of TECS is governed by regulatory frameworks and standards, and how mainstream technologies can be deployed by local authorities, used in the same care settings and comply with these standards, without stifling innovation, is an important question. Already there have been calls for regulatory frameworks *"flexible and robust enough to ensure the reliability and safety of future care applications"* (TSA, 2017, p. 8).

Further research into the outcomes of using mainstream technologies' in ASC is an important next step in exploring their potential role. This should be informed by insights from the literature on STS and domestication, and focus on whether mainstream devices are deployed with users' own aspirations in mind. In commissioning TECS, 'what works' and cost savings have often been the focus, with critical questions about outcomes, what works *for whom*, and their ability to meet users' aspirations, neglected. Evidence- and outcomes-based commissioning guided by such research should help ensure such technologies are deployed appropriately.

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[12] There are examples of local authorities taking an 'outcomes-based' approach to commissioning mainstream technologies. Hampshire County Council received Local Government Association 'Local Investment Programme' funding to explore potential mainstream devices of possible use, rather than substitute analogue TEC devices (TSA, 2017).

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