Peer-reviewed paper

The development of safer walking technology: a review

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Received 21 October 2014
Revised 16 January 2015
Accepted 16 January 2015

This literature review was conducted as part of ongoing PhD studies undertaken by Esmé Wood at the Coventry University. The co-author's listed in this paper are members of the PhD supervisory team.

Abstract

Purpose – *The purpose of this paper is to gain a greater understanding of the development of safer walking technology for people with dementia through contemporary literature.*

Design/methodology/approach – *A two stage systematic approach to searching the literature was adopted. Initially this involved searching the literature to gain a broad overview of the development of safer walking technology and the context in which it has been developed. Then, this literature was examined in detail to look at published evidence surrounding the use of safer walking technology by people with dementia. These articles were quality appraised and a meta ethnographic approach taken to synthesis of the findings.*

Findings – *There is a small but growing body of literature within this field. Whilst there is only limited evidence to support the use of safer walking technologies for people with dementia, the evidence to date indicates great potential for its use. If provided with the right support and guidance, safer walking technology has the potential to increase freedoms and independence for people with dementia; gaining them improved access to outdoor spaces and environments to support their health and wellbeing. However, if the safer walking technology continues to be associated with only risk management it will not achieve this potential.*

Research limitations/implications – *The published literature within this field is small and has limited generalisability as much of it was generated in recent years has been by the same small research teams, often reusing data sets. There is also very little research that examines the experience of actually using safer walking technology and even less which explores the views of people with dementia. It is evident that a greater breadth and depth of knowledge is needed within this field to develop a clearer understanding of how this technology is used and perceived by all stakeholders concerned. In particular the literature would benefit from greater consideration of the views and experiences of people with dementia themselves.*

Practical implications – *For many people with dementia, health and social care professionals can play an important role in ensuring appropriate assessment and support in the decision-making process when using safer walking technology. However, greater support is needed in decision making for all people with dementia, especially those people not currently engaged with specialist services. Therefore greater awareness of the benefits and limitations of this technology is needed by all health and social care professionals as well as the general public.*

Originality/value – *At the time of conducting this review the author is unaware of any other systematic search of literature or overview of research on the use of safer walking technology and its use by people with dementia. Despite this safer walking technology is growing in popularity, commonly recommended by health and social care practitioners and often marketed and purchased directly by people with dementia and their families. This review offers an insight into the development of the technology and the current evidence base for its use.*

Keywords *GPS, Accessibility, Dementia, Walking, Nature, Safer-walking*

Paper type *Literature review*

Introduction

Walking is viewed as a healthy occupation, promoting both good physical and mental health, (Chief Medical Officers, 2011) particularly when it is undertaken outdoors, (Wensley and Slade, 2012). It is promoted to the general public through a range of schemes such as the "Walking the

way to Health Initiative" (WHI) and Walk4Life campaigns (Department of Health, 2011) which seek to improve health and wellbeing through walking and access to outdoor environments. This agenda has particularly been targeted at older people and the last 15 years of government policy in the UK have included repeat commitments to achieving the goal of healthy "active ageing" (Age UK, 2010, p. 4). The World Health Organisation (WHO) in particular has identified the need for age-friendly cities as they encourage active ageing by optimising opportunities for health, participation and security in order to enhance quality of life as people age. According to the WHO guide to global age-friendly cities (2007, p. 13) one key feature of an age-friendly city is the existence of green spaces to promote both "green exercise" such as walking and enable space for connections to nature. This in turn has led to a number of research projects championing the need for greater access to green outdoor environments to promote wellbeing and quality of life in older people (I'DGO, 2013).

Within the field of dementia research there is also a small but growing interest in the therapeutic benefits of outdoor environments and access to the natural world, (Chalfont, 2008; Gilliard and Marshall, 2012; Rappe *et al.*, 2006). In a recent multifaceted study Mapes (2011) explored the benefits of green exercise for people living with dementia; he found that there is a fundamental connection between nature and a strong sense of place, based on a strong emotional connection and need for nature. Mapes suggests that living well with dementia depends upon regular contact and connection with nature. He argued that all people with dementia should have the opportunity to experience the benefits of contact and connection to nature whilst participating in exercise such as walking. However, the realities of enabling access for people with dementia to outdoor environments are complex in an increasingly risk adverse society (Taylor and Donnelly, 2006).

What is safer walking technology?

A range of assistive technology solutions known as "safer walking technology" have been developed which seek to track, find, support or safeguard individuals with dementia when accessing outdoor environments. Whilst safer walking technology comes in a number of different formats and is being developed by a range of manufacturers/ suppliers, the types of technology currently available for use can be broken down into three main types:

1. Technology which informs the user of their whereabouts, such as handheld satellite navigation - ideal for rambling in open countryside.
2. Technology which informs the user where someone else is, such as GPS trackers - typically worn as a watch or an a keychain. These are useful for identifying current location, for returning to a specific location such as home or a parked car or finding a person if they become lost.
3. Technology which has the potential to do both of these tasks and be tailored to meet very specific needs or tasks. These are mainly being developed as mobile phone/tablet apps. New apps are being developed all the time to suit a range of specific uses where user has access to 3G or 4G networks.

The technology in this field was initially developed to manage behaviour perceived as challenging and to reduce the risk of harm if an individual were to become lost (Robinson *et al.*, 2007a, b). More recently safer walking technology has been used to promote greater confidence to enable people with dementia to go out independently and engage in outdoor activities such as walking. The Alzheimer's Society (2007, p. 2) supports the use of safer walking technologies, stating that they have "the potential to enable some people with dementia to have greater freedom and independence". However, this technology also has the potential to decrease autonomy and restrict movement, raising potential ethical questions around confidentiality and loss of privacy (Hughes and Louw, 2002) and has been associated with negative terminology such as tagging and tracking (Plastow, 2006).

Within a systematic review that looked at assistive technology in dementia care Topo (2009) reports that the number of overall studies undertaken on assistive technology and dementia are limited compared to other fields of dementia research. The review also reported that research within this field was much more biased towards the residential care setting, with only ten out of

the 66 studies describing their aim as being to support the wellbeing and independent living of a person with dementia living at home. This research profile is therefore not reflective of the needs of people with dementia in the UK today, where two-thirds of people with dementia live within their own homes (Alzheimer's Society, 2013).

Despite various forms of assistive technology such as motion detectors and medication prompters being recommended by the Department of Health (2009) and National Institute for Health and Clinical Excellence (NICE) (2006), knowledge about how technology can be used by people with dementia and access to that technology is variable (The Alzheimer's Society, 2011). Godwin (2012) reports that this is partially due to ethical concerns around surveillance and the rights of the individual, but may also be related to the rapidly changing nature of the technology itself (Cahill *et al.*, 2007). There is also some variability in the level of priority that the provision of assistive technology is given by local authorities and health trusts. Where these technologies have been shown to be both helpful and cost effective there has been an increased uptake (Department of Health, 2008). However, a recent systematic review (Fleming and Sun, 2014) of the empirical support for the use of assistive technology for people with dementia found that the published research was often of poor quality and concluded that to date the research has been unable to establish a positive difference to the lives of people with dementia through the general use of assistive technology. It is clear that there is an acknowledged danger of assistive technology being seen as a panacea (Woolham, 2006, p. 5) and the very real and subtle needs of the individual may be lost (Gilliard, 2001). Yet, despite this there are examples of good practice, and innovative use of assistive technology published within the dementia press. For example, Bendall (2014) reports on the effective introduction of MP3 players, tablets and smart phones to enable greater access to music for people with dementia in the London Borough of Waltham Forest. This example highlights the provision of such technology in a more person-centred and individualised way.

This review explores the published literature, which examines tracking, and safer walking devices from the early beginnings of this technology to its use today. Astell (2006) challenges us to question what is driving these developments:

- Is it the need and wishes of people with dementia?
- Do these developments reflect the priorities and concerns of caregivers?
- Are the advances determined by the potential of the technology itself?

These three motivations for technological developments have considerably different implications for people with dementia. This review seeks to answer these questions in relation to safer walking technology by examination of the development of this technology and its use within the evolving dementia care culture.

Methodology

A two stage systematic approach to searching the literature was adopted, initially this involved searching the literature to gain a broad overview of the development of safer walking technology and the context in which it has arisen. Then in the second stage, this literature was examined in detail to look at primary research around the use of safer walking technology by people with dementia. These articles were quality appraised and a meta ethnographic approach taken to synthesis of the findings. As required by the researcher's institution, ethical approval was sought and gained for both the preliminary and main literature search strategies within this study. Both projects were approved as low-risk projects, reflecting some low- level risks associated with using the internet and accessing both government web sites and online databases.

The use of subject headings, and additional keywords enhanced the search strategy for the main review. Using both keywords and subject headings together greatly increases the scope of the literature search; this is particularly helpful where no "defined terms" or vocabulary exist within the literature (Hart, 2001, p. 28). Keywords and database-specific subject headings were identified from reviewing common terms and words within the papers found and within the preliminary database search; these are shown in Table I.

Table I Key words and subject headings used

Database	*Subject database within locate*	*Subject headings identified*	*Keywords*
CINAHL	Allied health assistive technology	Dementia Alzheimer's disease technology assistive technology	Dementia OR Alzheimer's disease
MEDLINE	Allied health assistive technology	Dementia Alzheimer's disease self-help devices	and
AMED	Allied health assistive technology	Dementia Alzheimer's disease technology	assistive technology OR tagging
PschINFO	Allied health assistive technology	Not available in database	OR tracking
Academic search complete	Allied health assistive technology	Dementia Alzheimer's disease self-help devices	OR outdoor mobility OR
ASSIA	Allied health assistive technology	Not available in database	safer walking
SCOPUS	Allied health assistive technology	Not available in database	

The search strategy also included the use of citation tracking, snowballing and hand searching of identified journals. The research references in all identified articles were then also searched in a process known as "snowballing" (Booth *et al.*, 2012, p. 78). Citation searching is extremely helpful in tracing the development of a body of literature and has been shown to identify studies missed from the main bibliographic search (McNally and Alborz, 2004; Papaioannou *et al.*, 2010). Finally, hand searching the contents of key journals identified within the preliminary search was completed for volumes published between 2000 and 2014. This resulted in the identification of 616 published articles, which were then reviewed by reading their title and abstract, after which they were either categorised as relevant to the literature review or rejected. Research articles which were rejected for being not relevant to the review focused on a wide range of topics, most common were those with a focus upon "the use of technology to support independence within a client's own home" and "the use of technology to support diagnosis within dementia car33e". The total number of articles identified, as being relevant to the study was 121. The search methods used and number of identified articles after review can be found can be seen in Table II.

All 121 articles were then read in full, forming the first stage of the literature review process. The findings of this stage of the review process are explored later within this paper. For the second stage of the review, the 121 articles were then also searched to explore the use of safer walking technology in primary research studies with people with dementia. To ensure appropriate literature was selected an inclusion / exclusion criteria was applied, this is shown within Table III. This considered a range of issues and pragmatic issues. For example, the relatively new concept of using tracking technology in this way and the great developments in technology innovation over the last 20 years led to the decision to only search literature from 1994 onwards. The choice of this specific date was determined by a brief preliminary search, which was unable to identify

Table II Number of articles identified

Search method	*No. of articles identified*
Electronic databases	112
Citation tracking and snowballing	8
Hand searching identified journals	1
Total number of articles identified	121

Table III Inclusion/exclusion criteria

Inclusion	*Exclusion*
Published 1994-present	Published before 1994
Mention of safer walking technology	No mention of safer walking technology
Primary research study	Secondary review or opinion piece
Published in a peer-review journal	Not published in a peer-review journal

literature of relevance before this date. Application of the inclusion/ exclusion criteria reduced the total number of studies for inclusion in the study to 18.

Quality appraisal

It is not enough to just assume that research found for the review is of a good quality because it has been published within a peer review journal. Such research can vary considerably in methodological rigour and the conduct of the study and/or flaws in the design can produce bias. Therefore failure by the reviewers to apply systematic methodologies to the process of reviewing the evidence could lead to biased conclusions, (Wallace *et al.*, 2004). The NHS Critical Appraisal Skills Programme (CASP) (2002) was used for quality appraisal of the articles found. CASP is based upon an appraisal tool originally published by Oxman *et al.* (1994). The CASP consists of ten questions designed to highlight key components of good quality reviews. The first two questions within the CASP are designed specifically for screening. After this the subsequent eight questions allow a robust appraisal. Within the published literature there is no settled consensus about the value of such appraisal tools and some have argued that quality cannot be determined by following prescribed formulas (Buchanan, 1992). Whilst acknowledging this debate, the first two screening questions from the CASP tool were used specifically to identify those studies that were fundamentally flawed or particularly weak in methodology, based upon opinion or conjecture. The quality appraisal rejected further studies and 13 articles were identified from within the literature identified in stage 2 that described primary research that looked at the use of safer walking technologies (or their assistive technology predecessors) by, with or for people with dementia. These studies all met both the inclusion/exclusion criteria and the requirements of the quality appraisal tool. The studies have been numbered for ease of discussion and this can be found in Table IV.

Data extraction and analysis

Use of a non-standardised data extraction tool enabled a clear comparison of the research methods and overview of findings from these studies. Of the 13 studies identified, eight used quantitative methodology, four used qualitative methodology and one adopted a mixed method approach; with the most common forms of data collection being questionnaires and surveys. It was not uncommon for researchers to use data collected from one study within another. It was also evident that there is just a small community of researchers who have undertaken research within this field in recent years, as much of the research was by the same authors. According to Pienta *et al.* (2010) the foundation of the scientific process is that research should build on previous work, where applicable, and data sharing makes this possible. However, re-using data sets removes the researchers from the original context and meaning in which they were collected. This is especially dangerous for qualitative research; as the information within one data set could bias the outcomes of several studies. Inside a small field of study such as this, this could then influence much of the decision making and clinical practice in this area. Within this review the findings of all the identified studies were considered, but it was also important to note the potential bias created by the large percentage of the studies that came from the same research team and relied on the same data sets.

Once all the research had been identified the process of synthesising its findings could begin. This study used a meta ethnographic approach to aid synthesis. Meta ethnography provides an alternative to traditional aggregative methods of synthesis. It is a method that involves induction

Table IV Studies included within the review

	Authors	*Year*	*Title*
1	Hughes, J., Newby, J., Louw, S., Campbell G. and Hutton, J.	2008	Ethical issues and tagging in dementia: a survey
2	Landau, R., Werner, S., Auslander, G., Shoval, N. and Heinik, J.	2009	Attitudes of family and professional care givers towards the use of GPS for tracking patients with dementia: an exploratory study
3	Landau, R., Werner, S., Auslander, G., Shoval , N. and Heinik, J.	2010	What do cognitively intact older people think about the use of electronic tracking devices for people with dementia? A preliminary study
4	Bantry White, E.B., Montgomery, P. and McShane, R.	2010	Electronic tracking for people with dementia who get lost outside the home: a study of the experience of familial carers
5	Landau, R., Werner, S., Auslander, G., Shoval , N. and Heinik, J.	2011	Who should make the decision on the use of GPS for people with dementia?
6	Landau, R. and Werner, S.	2011	Ethical aspects of using GPS for tracking people with dementia: recommendations for practice
7	Sorri, L., Leinonen, E. and Ervasti, M.	2011	Wayfinding aid for the elderly with memory disturbance
8	Grierson, L., Zelek, J., Lam, I., Black, S. and Carnahan	2011	application of a tactile way-finding devise to facilitate navigation in persons with dementia
9	Werner, S. and Landau, R.	2011	Social workers' and students' attitudes towards electronic tracking of people with Alzheimer's disease
10	Dahl, Y. and Holb, K.	2012	"There Are No Secrets Here!": professional stakeholders' views on the use of GPS for tracking tracking dementia patients
11	Bantry White, E.B. and Montgomery, P.	2012	Electronic tagging for people with dementia: an exploratory study of the ethical issues experienced by carers in making decisions about usage
12	Pot, J., Wilemse, B. and Horjus, S.	2012	A pilot study on the use of tracking technology: feasibility, acceptability, and benefits for people in early stages of dementia and their informal carers
13	McCabe, L. and Innes, A.	2013	Supporting safe walking for people with dementia: user participation in the development of new technology

and interpretation, and is suitable for use with both qualitative and quantitative research results, (Britten *et al.*, 2002).

Findings

Stage 1 of the literature review identified 121 articles of relevance to the use and development of safer walking technology for people with dementia but not all of these directly explore the technology as it exists today. The published data identified begins in 1994 and gradually increases in volume to the present day. The published articles range from descriptions of technological developments and primary research to opinion pieces and clinical frameworks. Of these identified articles 39 discuss safer walking technology directly and the remaining 82 describe research or expert opinion of relevance not the development of safer walking technology or walking/wandering in dementia. This literature gives a great wealth of information about the context and influences on the development of this technology from its very early stages. Review of these findings identifies a clear trend towards greater use and prevalence of safer walking technology. It also highlights the limited number of primary research studies undertaken in this field compared to the increasingly prevalent opinion pieces discussing its use.

Initial reading of the 121 articles identified paints an evolving picture of the way this technology is used by and to support people with dementia. Throughout its development safer walking technology has been influenced by the limitations and advances of the technology itself, (Dale, 2010; Miskelly, 2004; Rasquin *et al.*, 2007) and by the shifting culture of dementia care within society. In particular it reveals the development of safer walking technology in the context of wider community living (Holbø *et al.*, 2013) and earlier diagnosis (Iliffe and Manthorpe, 2007). As this culture changes, the trends within the literature also indicate changing attitudes and terminology in societal perceptions of walking (Marshall and Allen, 2006) and outdoor mobility for people with dementia (Buettner and Fitzsimmons, 2002). This is unsurprising as literature include within stage 1 of the review is published through the last 20 years which has seen increased prevalence, changing societal attitudes and an ever developing culture of dementia care. Throughout this

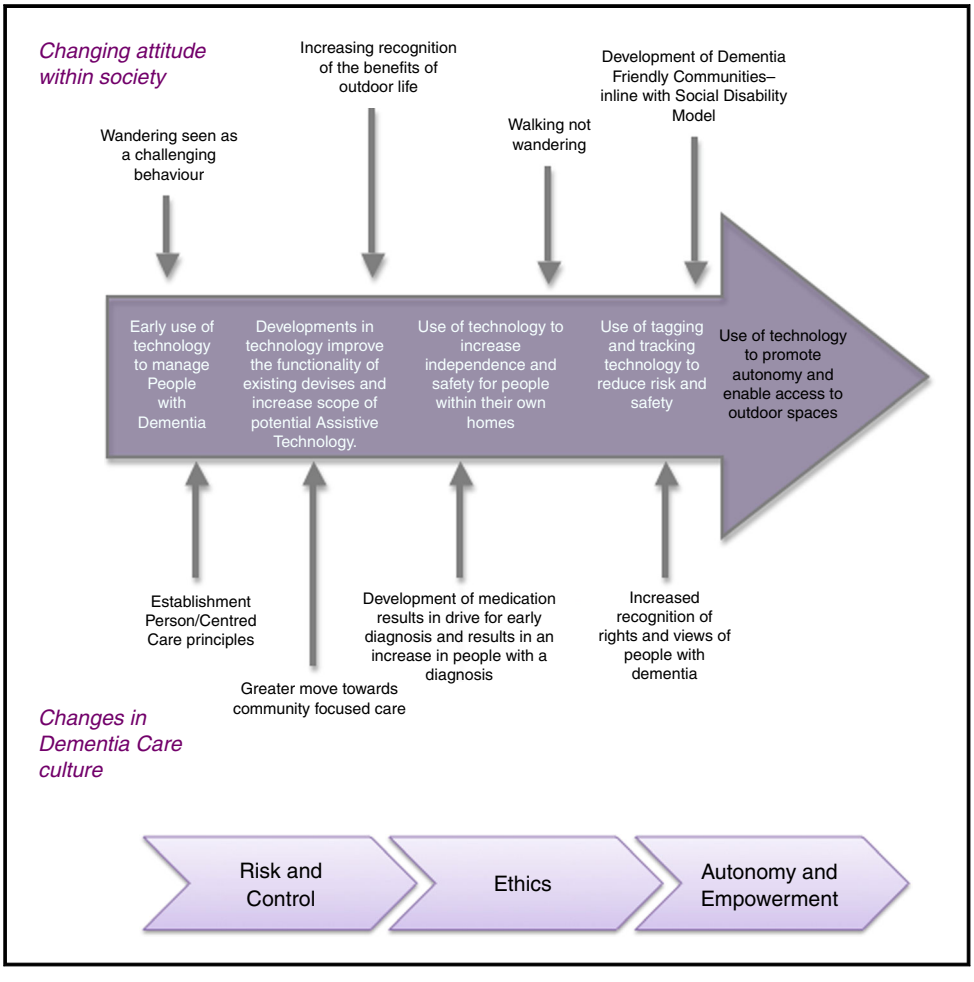
period there are key debates and concepts that feature within the literature. These influences and how the technology's purpose has evolved can be seen in Figure 1.

Of the 13 studies identified within stage 2 of the review only two were based around the development or specific design of a technology product. The remaining 11 studies all sought to explore views and attitudes towards the use of safer walking technology, although only three of the studies specifically sampled people who had experience of using a form of safer walking technology. There was a clear interest in what factors informed decision making on the use of the technology and views were sought from a wide range of stakeholders including people with dementia, cognitively intact older people, family carers, professional carers and other health and social care professionals. It is also of note that study 13 (McCabe and Innes, 2013) was the only one to seek the views of people with dementia, although this is done within a focus group setting with a number of other stakeholders, including carers present.

Discussion

Figure 1 also shows how within the literature the focus of research and academic discussion evolves over time from discussions of risk and control (McShane *et al.*, 1998) to ethical debates (Hughes and Louw, 2002; Plastow, 2006; Robinson *et al.*, 2007a, b) and more recently the use of technology to promoting choice, autonomy and empowerment (Mahoney and Mahoney, 2010; Wigg, 2010). This change and development in focus can also be seen within the 13 articles

Figure 1 Evolution of academic discussion within the literature



identified within stage 2 of the literature review. In the following discussion each concept is explored in more depth followed by consideration of how safer walking is used today.

Risk and control

Issue of risk and control feature heavily in the early published literature and discussion around the use of safer walking technology is often framed within the context of reducing "wandering behavior" rather than the support of outdoor mobility and/or safer walking (Robinson *et al.*, 2007a, b). Safer walking technology has been under development for a number of years and was originally aimed at managing this perceived risk, and safeguarding individuals by enabling "lost" individual's to be found (McShane *et al.*, 1998). First generation tracking technology was often underused, perhaps because it was bulky, heavy, expensive, unreliable due to battery life, for example and even if there was an awareness that it existed, it may seldom have been used as the likelihood of an individual getting lost was not always recognised (Rowe and Benito, 2007). Yet the "management of risky behavior" and prevention of harm continues to be a key motivating factor in the ongoing development of safer walking technologies.

Risk management and safety issues for older people have tended to be discussed in ways that reflect an inherent "vulnerability" because of physical or mental impairments. Yet there is a growing recognition within the caring professions that the issue is not necessarily the vulnerability of the people themselves; rather, it is their circumstances that mean they are more likely to face abuse or restraint than other people (Hughes, 2010). For many of the participants in the studies identified in stage 2 of the literature review; issues of reducing risk and increasing safety were key to the use of safer walking technologies. Studies 4 (White *et al.*, 2010) and 11 (White and Montgomery, 2012) both describe the same research results which sought to explore the experiences of family carers in using safer walking technology. They found that carers in the sample drew upon consequentialism, the fear of what might happen, to justify usage on the grounds of enhanced safety, where risk taking was consistently judged negatively. However, their findings did indicate that although GPS tracking was most commonly used as a back-up to other strategies of support, for a small minority it was used to enable the person to go out alone. Similar findings were shown in study 3 (Landau *et al.*, 2010) which sought the views of "cognitively intact older people". Within this study Landau *et al.* found that participants supported the use of tracking technology for the sake of patient safety and the sake of caregivers' peace of mind, an aspect that appears to reflect their empathy and concern for the caregivers' wellbeing. The study concludes that participants value the safety and protection of people with dementia, even if it means a disregard for their autonomy and privacy. Landau *et al.* do not explore the specific reasons for sampling this group of cognitively intact older people, but it is inferred that because of the participant's closeness in age to most people with dementia they represent views likely to be similar to those of people with dementia. This raises the question of why this group were asked to participate instead of people with dementia themselves?

In contrast to the findings above, study 9 (Werner and Landau, 2011) suggest that social care professionals are more likely to acknowledge the decisions made autonomously by the person with dementia. They suggest this is due to a focus on the concepts of autonomy, beneficence and justice within their professional training. Although the application of these principles in practice is challenging, in study 10 Dahl and Holbo (2012) explored the use of tracking technology with a group of different professional stakeholders and found that the main issue highlighted was in finding the right balance between what is thought to benefit the individual with dementia and preserving his or her right to privacy. The study found that professional stakeholders have different attitudes towards electronic tracking of people with dementia, dependent upon their specific responsibilities. This is also reflected in the findings of study 1 (Hughes *et al.*, 2008) which also sought the views of different professional groups.

Ethics

Consideration of ethical issues surrounding the use of safer walking technology have been present since the early development of this technology (McShane and Hope, 1994). The association, particularly for tracking technology, with its use to track and locate both animals and

criminals has raised a number of objections within the UK press (The Telegraph, 2013) and professional literature. There is also well-documented concern about the individual right to privacy (Astell, 2006) and the potential reduction in human contact from the introduction of tracking devices (O'Neil, 2003). Despite these negative associations there have been continual demands for its use to support people with dementia (Dahl and Holbø, 2012; Hughes *et al.*, 2008; McShane *et al.*, 1998). Both studies 1 (Hughes *et al.*, 2008) and 6 (Landau and Werner, 2012) specifically explore the ethical issues surrounding the use of safer walking technology for people with dementia. Within study 1 Hughes *et al.* draw on previous research (Hughes and Campbell, 2003) to discuss the need for protocols and risk assessments to enhance the ethical process and support the use of safer walking technology. However, within this study they found a mixed response from participants, with 18 per cent of respondents stating that they did not think electronic tagging would increase freedom and another 22-23 per cent stating they were unsure if it would. Hughes *et al.* (2008) conclude that whilst acknowledging the concerns about liberties, stigma and dignity, electronic tagging is an ethical way to support people with dementia because of the potential freedoms it offers. This is also supported by the findings of study 6 (Landau and Werner, 2012) which reviewed existing research within this field and presents eight recommendations to guide ethical practice in using safer walking technology for people with dementia. These recommendations cover a variety of issues including joint decision making, informed consent and balancing the protection and safety of the individual with the need for autonomy and privacy. The recommendations are brief but specific and written in an accessible way. They are based on a substantial body of research and offer clear guidance to professionals and carers alike about ethical use of safer walking technologies.

The introduction to this review considered Astell's (2006) questions. What is driving these developments:

- Is it the need and wishes of people with dementia?
- Do these developments reflect the priorities and concerns of caregivers?
- Are the advances determined by the potential of the technology itself?

These questions are of particular relevance when considering studies 7 (Sorri *et al.*, 2011) and 8 (Grierson *et al.*, 2011) which both explore the development of way finding technology for use by people with dementia. In both cases the research focuses upon the successful use for the technology to guide a person with dementia around a specific pre-determined route. There is considerable potential for the development of way finding technology to provide a means for greater autonomy and independence for people with dementia in navigating successfully around both indoor and outdoor environments. However, both of these studies pay little attention to the attitudes and values of the person with dementia. In study 7 the participants are not questioned about their experiences at all, whilst in study 8 a short questionnaire was administered following the technology trial to collect numeric data about the effectiveness of the technology.

These studies also demonstrate a lack of insight into issues of acceptability and stigma in the product design, a significant factor described in study 3 (Landau *et al.*, 2010) as essential to effective safer walking technology and discussed at some level in all of the other studies. The equipment needed for the technology described in study 7, for example, includes both a ten-inch screen fitted to a walking frame, vibrating wristbands and a Bluetooth earpiece. The study does not at any point consider the acceptability or wearability of this technology. Within the recommendations for ethical use of safer walking technology described in study 6, recommendation eight states that devices used to support people with dementia need to be lightweight, small and comfortable to wear and use. The recommendation was made in response to participants' concerns within the study that highlighted the potential for the devices to be inconvenient or increase stigma. This also correlates with the findings of study 13 (McCabe and Innes, 2013) which used focus groups to explore the ideas and opinions of potential users about a specific GPS device. Within this study McCabe and Innes found that people with dementia were less concerned about the wider ethical debate, but did raise concerns about the potential stigma from the product design. The importance of designing products which are acceptable to users, discreet and do not increase stigma is well documented within the literature (McCreadie and Tinker, 2005; Westphal *et al.*, 2010; Zwijsen *et al.*, 2011) and should be a priority

for the development of all forms of assistive technology. However, this cannot be said of the technology described in studies 7+8, and these studies would benefit considerably from a more in-depth consideration of the views and preferences of people with dementia. It is argued by Kearns *et al.* (2007) that in order to achieve this companies need to work closely with both people with dementia and their carers to ensure devices meet their actual needs. This joint working was precisely what is being described in study 13 and through the study McCabe and Innes (2013) were able to show that assistive technology and in particular GPS tracking was of interest to potential users and that they were enthusiastic about the potential benefits to their lives.

Autonomy and empowerment

Another study that successfully sought the views of people with dementia and their carers was study 12, (Pot *et al.*, 2012). Through a quantitative survey this study explored the views and experiences of 343 people with dementia and their main carer in the Netherlands, all of whom had undergone a trial of safer walking technology. The findings from this study were very positive, indicating that almost half of the participants with dementia experienced more freedom and were less worried when they were outside on their own, a quarter mentioned that they were outside independently more often. However, the study did have some drop out, which showed that the technology used in the study was only appropriate for those with early-stage dementia. Interestingly, as their dementia progressed a number of the participants stopped using safer walking technology indicating that there is a potential window of time where the technology is useful for each individual. Pot, Wilemse and Horjus also indicated that decision making around the use of safer walking technology should include the person with dementia and their carers but also professionals involved in their care.

The attitudes of family and professional carers towards the use of GPS tracking technology were explored in Study 2 (Landau *et al.*, 2009), which found that across both of these groups attitudes varied and were complex. In comparing family and professional carers, the family carers showed greater support for the use of safer walking technology, both for their own peace of mind and the safety of the person with dementia. This is similar to the findings discussed previously. However, study 2 also indicates that when compared with family carers, professional carers attached a higher value to respect for a person's autonomy and greater support for the person with dementia's participation in the decision-making process. Study 9 (Werner and Landau, 2011) also looked at autonomy and the role of the person with dementia. This study explored the attitudes of both student and experienced social workers and found that for this professional group the value of respecting a person's autonomy is perceived as independent of, and does not contradict, the use of safer walking technologies.

Implications for practice

Almost all of the studies reviewed considered the role of professionals in supporting people to make decisions about the use of safer walking technology. Yet, in study 5 (Landau *et al.*, 2011) the research indicates the need for a more active role by professionals in this. Landau *et al.* call for a clearer "family decision-making process" facilitated by professionals to protect the person with dementia's autonomy and independence. A view also supported by the findings of study 4 (White *et al.*, 2010) which argues that Occupational Therapists in particular are well placed to support family carers in assessing the suitability of this technology. Occupational Therapy operates within an enabling paradigm that emphasises ability, wellbeing and quality of life (Moniz-Cook and Vernooij-Dassen, 2006; Mountain, 2006). Providing that support may be challenging, as the findings of study 5 indicate that family carers and "cognitively intact older people" rate the multi-professional team as the "least important" figures in the decision-making process around the provision of safer walking technologies. Dunk *et al.* (2010) describe the pilot use of GPS location equipment within an NHS Mental Health Trust. From this trial a process for assessment and provision of the technology was developed and provided within the article. Although this was a small-scale pilot within one NHS trust the observations of the clinical Occupational Therapist's reporting on its success conclude that the trial had been overwhelmingly positive for both people with dementia and their carers.

It should also be acknowledged that not all people with dementia and their families have direct access to Occupational Therapist's and other specialist health and social care professionals. In the UK only 44 per cent of people in the UK with dementia receive a formal diagnosis of dementia, (Alzheimer's Society, 2013) and the majority of those who do have a diagnosis are seen in primary care services only (Department of Health, 2009) with their welfare monitored by their general practitioner. In response to this need the UK Alzheimer's Society has produced a guidance document for people with dementia and their families in decision making around this technology, it is called "Safer walking technology" and freely available on their web site (The Alzheimer's Society, 2007). Another useful resource freely available to people with dementia and their families on the internet is the web site AT dementia (2013). This web site seeks to provide independent, accessible information on assistive technologies for people with dementia, families and professionals (Burrow and Brooks, 2012). Amongst the many resources found on the web site is a guidance document written by Occupational Therapist Stephen Wey (2007) on the ethical use of assistive technology. Wey advises that if the use of safer walking technology is to be encouraged as an empowering tool to enable greater independence rather than just a risk management strategy, greater support is needed in the decision-making process for those individuals not currently engaged directly with services.

Key messages

- It is clear from the findings of this review that the use of safer walking technology has evolved and is now used with a greater emphasis upon promoting autonomy and independence, This technology offers great opportunity to improve the quality of life for the individual and is growing in popularity and availability due to increased demand.
- This review also indicates that a greater awareness of safer walking technology and its potential as an enabling tool is needed amongst both health professionals and the general public alike.
- Key to its successful provision is a family-based decision-making process around the use of such technologies, which should be supported where possible by the health and/or social care team involved with the individuals care and if no such team exists primary health care services should either provide written guidance or signpost onto the online guidance currently available.

Implications for research

It is likely that the developers of safer walking technology devises are likely to undertake both market research and product usability studies – although few if any of these are likely to be published. However, it is evident from this review that a greater breadth and depth of knowledge is needed within this field to develop a clearer understanding of how this technology is used and perceived by all stakeholders concerned. How this technology is used, how it could be used and how it could be developed further are all areas of potential research interest for clinical professional and academic researchers alike. This review provides a background context to the development of this technology and so informs any future research, consolidating the existing knowledge in this field whilst highlighting the need for greater investigation.

In particular, this review highlights that the published literature would benefit from greater consideration of the views and experiences of people with dementia. As the users of this technology their views are woefully under-represented in the existing research. In response to this, future research should be undertaken to develop a greater understanding of how the use of safer walking is experienced by the individual; this could be achieved through a range of research methodologies, but may be best suited to qualitative research methods with a focus on the experience of the individual (Taylor, 2007). This could then potentially provide insight into the intrinsic motivations and lived experiences associated with the use of safer walking technology by people with dementia and in turn how this informs our understanding of the benefits of accessing outdoor environments on the health and wellbeing of people with dementia.

Limitations of the review

Despite the continual discussion and debate within the professional literature (Daniels, 2008; Desmond O'Neill, 2013; Gilliard, 2001; Sturdy, 2005), there are only a limited number of primary research studies within this field. As discussed earlier, of the 13 that met the inclusion/exclusion criteria and quality appraisal standards for this study a number of the studies were the work of the same research team and shared data. This reduces the trustworthiness of the overall reviews findings as much of the same data are examined and re-examined to find new meaning and could hold considerable bias, which could in turn bias the findings of this review. Most of the studies were also small-scale preliminary work or had limited generalisability, although the transferability is not always the aim of all qualitative research but of understanding "common meanings and experiences", (Smith *et al.*, 2009, p. 3). So far, only a small community of researchers, often working in partnership with companies seeking to develop this technology, has conducted primary research within this field. Whilst the benefits of this partnership working have already been acknowledged it should also be note that this does not necessarily promote the exploration of alternative non-technological ways of promoting safer walking, or encourage the publishing of material that presents a poor picture of the products use. Safer walking technology is only one strategy and is not appropriate for everyone (Steggles, 2007).

Only a few of the studies included within the review sought the views of people with dementia, yet almost all of the studies call for greater inclusion of the voice of people with dementia in their conclusions or reflective limitations. This is not uncommon in current published literature and another systematic review (Robinson *et al.*, 2007a, b), which looked at a range of non-pharmacological interventions to prevent wandering in dementia, found that none of the papers reported the views of people with dementia either.

A number of the studies also used survey questionnaires to collect nominal data about participant's attitudes and experiences. However, where this was completed using a small sample size the findings and conclusions drawn through quantitative analysis were of limited value. This can be a common problem where quantitative data is collected from a sample too small to produce a statistically significant result (Kielhofner, 2006). It may have been more effective to capture the experiences of these individuals through a more qualitative approach, to ensure a depth of data where a breadth of data were unobtainable.

Conclusion

Whilst it is clear that there is only a limited research evidence to support the use of safer walking technology for people with dementia, the evidence so far indicates great potential for its use. If provided with the right support and guidance, safer walking technology has the potential to increase the freedoms and independence of people with dementia offering them improved access to outdoor spaces and environments. Yet current attitudes and beliefs around the use of the technology from familial carers and professionals alike still frame the use of safer walking technology in the context of risk management and ethical concerns. If safer walking technology is considered an intervention only for use by those most "at risk" it becomes an intervention of restraint (Dewing and Wilkinson, 2010) rather than something to empower and enable. It appears from the literature explored within the review that the provision of support during the assessment and decision-making process is key to effective use of safer walking technologies. However, many individuals and families are choosing to buy their own devices or download apps independently, therefore the need for provision of accessible information and guidance is increasing, and professionals need to signpost people and their families to these resources wherever possible.

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