Fall detectors: A review of the literature

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Fall detectors: A review of the literature.

Abstract

Purpose: The aim of this review was to explore recent literature regarding the development of fall detector technology. This work was completed as part of a service evaluation on the use of fall detectors across the region funded by NHS West Midlands. The application and the use of products designed to detect falls and alert for help was also explored from end user and health and social care staff perspectives.

Methodology: A comprehensive review of the literature of the last ten years was conducted, search terms were used to identify relevant literature from research databases and the main themes from the literature were summarised. This work was carried out to inform a service evaluation of the use of fall detectors across the West Midlands region and was funded by NHS West Midlands

Findings: It was found that whilst there are a wide variety of new technologies regarding fall detectors in development, the range of technologies currently available through health and social services to users are limited. Health and social care staff appear to be less convinced of the benefits of fall detectors than end users. There was also a lack of robust evidence regarding different approaches to technology in the management and detection of falls. Users had mixed views regarding the use of fall detectors, with some people having concerns about privacy, lack of human contact, user-friendliness and appropriate training, whilst others clearly identified the benefits of detecting falls and raising an alert. The implications of these findings for practice are discussed.

Value: This paper will be of value to those working in falls services, telecare or industry partners developing fall detector technology.

Keywords: Fall detectors, technology, service user views, staff views

Fall detectors: A review of the literature.

Much of the literature relevant to falls is related to preventing falls through exercise, multi-factorial interventions, environmental modification, the use of mobility equipment and assistive devices and the management of medication (Gillespie et al., 2009). However, the focus for this review is the use and application of technology designed to detect falls and alert for help after a fall. The review included the views of older people and carers and health and social care staff who are involved in the implementation of fall detectors.

Search Strategy

The following search terms were used to identify relevant literature:

- Fall(s) combined with: assistive devices, (electronic) assistive technology, monitoring, reporting, telecare, telemonitoring, environmental controls, detection, users, carers, emergency response systems
- Falls care pathway(s) with the above terms
- Falls with assessment and telecare

The terms were searched for on the following databases: CINAHL, EMBASE, SCOPUS, AMED, MEDLINE, COCHRANE Reviews and OT SEEKER. The search was limited to English language papers (UK and other countries) and those that were less than ten years old. Abstracts were read and a total of 87 papers were identified as relevant to the search. This was followed by a hand search of the reference lists of these papers. Members of the West Midlands Telehealthcare Network were also asked if they knew of any papers relevant to the project.

Background of Review

Given the impact that falls can have on older people and their families, many health and social care services are primarily focused on preventing falls and implementing interventions to reduce future falls in the older population (Gillespie et al., 2009). The healthcare costs for the older population are significantly higher than that of other population age groups (Porteus and Brownsell, 2000) and it is anticipated that the economic impact of falls will increase alongside the growing number of older people within the population. In 2010 the annual healthcare cost for treating falls in England and Wales alone was more than £15 million (Ward et al 2010).

Assistive technology can provide systems which aid prevention and detection of falls, leading to a fast response from health and social care professionals that can prevent the additional complications of a "long lie" on the floor such as dehydration and hypothermia. An estimated 30% of people who fall lie undetected for at least 1 hour (Fleming & Brayne, 2008). Studies indicate a direct correlation between recovery and how long people lie on the ground after a fall, indeed 50% who lie undetected for at least an hour will die within 6 months (Wild et al, 1981). Longer recovery time has both a human and a financial cost. According to the Royal College of Physicians (2007), falls present a significant problem for the health and independence of older people. The associated mortality and morbidity from a fall is high with individual consequences ranging from distress, pain, physical injury and loss of confidence to complete loss of independence which also impacts on relatives and carers. Financial costs can include extra home healthcare, social care or residential care (Royal College of Physicians, 2007). Irrespective of whether they injure themselves, some older people can develop a fear of falling that can cause restricted activity, reduced social contact, depression and increased risk of falling (Brownsell and Hawley 2004).

In relation to falls, assistive technologies can be broadly divided into two types, technology which aims to prevent a fall from occurring and technology which aims to manage the outcome of a fall after it has occurred. The latter are widely known as fall detectors, and are the focus of this review.

Development of Fall Detectors

Fall detectors, like other forms of telecare, can be broadly categorised into three groups (Martin et al., 2006):

- First-generation systems that rely on the user to detect the fall. Often known as a ‘community alarm’, and typically worn as a pendant around the neck, the user must push a button to contact the call centre or emergency services.
- Second-generation systems that are based on the first-generation systems but have an embedded level of intelligence (Porteus and Brownsell, 2000). The second generation comprises fall detection devices and life-style monitoring systems, and includes worn automatic fall detectors that are triggered without the wearer having to press a button.
- Third-generation systems use data, often via ambient monitoring systems, to detect changes (e.g. changes in activity levels) which may increase the risk of falling (or risk factors for other negative events). The third-generation systems are a more pre-emptive rather than reactive approach (Martin et al., 2006)

This review will describe the technologies available as first, second, and third generation as well as future developments for fall detection systems before going on to consider the literature regarding the use of fall detectors.

First-generation systems

Community alarms are the most common assistive technology device, even in light of the technological advances in assistive technology of the last fifteen to twenty years (Porteus and Brownsell, 2000). They have no embedded intelligent system and are reliant on the user raising an alarm to detect a fall through pulling a cord or pressing a button on a pendant alarm worn around the neck. The simplicity of the community alarm system is also its major limitation, the lack of an intelligent mechanism embedded within the device relies on the user to raise the alarm, which is impossible if the person is unconscious or out of reach of the alarm when they fall (Porteus and Brownsell, 2000). Community alarms have the benefits of providing 24 hour care while being potentially cost-effective for health and social care services. Porteus and Brownsell, (2000) predicted that community alarms will continue to be successful in the management of falls in the older population due to their simplicity.

Second-generation systems

The second generation includes automatic fall detection devices and life-style monitoring systems. The majority of automatic fall detectors are in the form of accelerometer devices worn on the body (Kangas et al., 2009). An accelerometer is a device for measuring acceleration and gravity induced forces (Dinh et al., 2009). Bourke et al. (2010) found that a device based on a tri-axial accelerometer using data on velocity, impact and posture was the most successful at detecting simulated falls, with high sensitivity and specificity rates and a false positive rate of less than one false positive per day in a laboratory-based study.

For users to feel secure, fall detectors need to be as accurate and reliable as possible, minimising or eliminating false positives and negatives (Chen et al., 2005). There have been documented difficulties with finding the right algorithm to achieve this balance, as there is often an overlap in the degree of acceleration associated with falling and the degree of acceleration associated with normal activities of daily living, e.g. sitting down abruptly (Chen et al., 2005).

Devices worn at the wrist are reported to have a lower sensitivity than those worn on the waist (Degen et al., 2003). Lindemenn et al. (2005) found that an accelerometer worn behind the ear had satisfactory sensitivity in simulated falls, and argued that placement of a fall detector on the head would allow the device to be worn at night, when there is a higher risk of falls when the person gets out of bed (Tinetti, Doucette and Claus, 1995; Lindemann et al., 2005). The waist or trunk of person is a popular site for fall detectors from a developers view point, due to improved reliability when detecting falls as the sensor is located near to the centre of the body (thus providing more information regarding body movement), and the sensors can be attached to, or hidden by clothing (Mathie et al., 2004; Bourke et al., 2010).

A recent laboratory-based study, observing people on treadmills presented with hazards likely to induce falls (e.g. a shoebox in the way of their feet), found that a single accelerometer placed on a person’s trunk was also able to detect near-falls as well as falls. It was argued that this information may be more clinically relevant than just measuring actual falls, as near falls could prove an objective measure of fall risk and may highlight when additional intervention is required. However, it should be noted that as yet such results have only been demonstrated in a laboratory, and not within a real-world environment (Weiss et al., 2010). Other researchers have found that using a combination of acceleration and posture data was found to be the best way to maximise the detection of actual falls whilst minimising the rate of false positives (Chao et al., 2009).

Acoustic and vibrational analysis can also be utilised in the detection of falls. This is where falls are detected from the waveform produced by a fall. Toreyin et al (2007) described a combination of passive infrared, sound and vibration sensors to detect falls with a minimum of false positives by using data from the three sources. However, the abundance of carpeting in UK homes may make this an untenable option (Doughty, Lewis and McIntosh, 2000a), and such a system may not recognise falls that occur without an impact, e.g. sliding off a chair or bed.

The integration of fall detectors into a user’s floor has also been considered as an option. (Aud et al., 2010) describe the development of “Smart Carpet”, a fall detector device embedded in a floor covering. The sensor within the floor covering can detect whether the carpet is being walked on, or whether someone is lying prone on the floor. The Smart Carpet also has the benefit that it does not require the user to remember to maintain the batteries, as it utilises “energy scavenging sensors”, which can harvest energy (such as light, thermoelectric and vibrational energy) from the surrounding environment (Tyrer et al. 2009; Aud et al. 2010; Paradiso and Starner 2005). Further, Aud et al., (2010) reported that participants found no perceptible difference between walking on the Smart Carpet and walking on a standard carpet, suggesting that this feature would enhance the acceptability of the fall detector. Field trials on the Smart Carpet are the next stage in the research (Aud et al., 2010). However, floor sensors have the problem of not detecting falls where the fall does not end on the ground, i.e. the person falls onto a piece of furniture (Noury et al., 2007). Also, detectors using such pressure-sensitive floors have not had their performance thoroughly tested (Helal et al., 2005). A recent study explored the use of electric near-field imaging in floor sensors, found that the system was not accurate when people fell to their knees, only detecting 20% of such falls (Rimminen et al., 2010).

Other methods of fall detection being researched include thermal imaging and video-based fall detection. Sixsmith, Johnson and Whatmore (2005) cited a pyroelectric infra-red sensor array device (thermal imaging) for fall detection, and argued that it negated the need for a user to wear a device to detect falls. However they found that whilst false positive rates were very low (with only one false positive during the trial being triggered), detection rates were also low at only 30%. However, these trials were conducted using one participant (an actress), performing various fall scenarios. Whilst the actress was required to replicate different types of falls, it is unclear whether these laboratory-based results would be replicated in a home environment with an older person prone to falls.

Rougier et al. (2007) and Zhengming et al. (2008) describe video-based fall detection systems which also do not require the user to wear a sensor. The sensors use 3D movement (horizontal and vertical movement), inactivity monitoring (Bobick and Davis, 2001) and change in the person’s shape to detect the likelihood of a person having fallen. Skubic et al. (2009) have also reported a video sensor which used a series of ‘fuzzy logic’ rules combined with images to distinguish between activities of daily living and falls. Toreyin, Dedeoglu and Cetin (2005) implemented an audio detector into a video fall-detector design, and found that the audio aspect was able to use the impact sound of a person falling as additional data, thus potentially reducing the likelihood of a false positive.

However, it has been reported that the video-based systems have a long way to go in their product development, in particular, to prevent false positives arising from users sitting down very abruptly (Rougier et al., 2007). A further concern is that video-based detection is likely to have low rates of acceptance, as users are required to have video-monitoring equipment in their rooms, particularly their bathrooms and bedrooms (Noury et al., 2007). There may installation and the associated equipment in all rooms of the home may be costly (Doughty, Lewis and McIntosh, 2000a). Further, it is unlikely that video cameras will be able to differentiate between particular individuals, e.g. distinguishing between the user and lively grandchildren (Marquis-Faulkes et al., 2005). Finally, the use of computer images to detect falls uses a great deal of electrical power, and therefore can have indirect financial costs to the service user or service provider (Rimminen et al., 2010).

Alternative lines of research include investigations into biomedical clothing (Weber et al., 2004) where fall detector sensors are integrated into the user’s clothing. This is thought to be an unobtrusive and acceptable method of wearing a monitoring technology (Kang et al., 2010), however, the practicality, acceptability and affordability of integrating technology into clothing has to be considered.

There has also been some work towards the development of devices which can detect a fall before impact, thus allowing the deployment of a product such as an inflatable hip protector (Nyan, Tay and Murugasu, 2008), which are designed to cushion the hip and prevent or limit breakage of bone.

Third-generation systems

Although initially designed for people with dementia, lifestyle monitoring technology could also be used as a third-generation system to monitor mobility patterns and identify where a decline in activity could be a predictor of an increased risk of falling. A combination of telecare and lifestyle monitoring can ensure that systems are in place to alert relatives or staff to changes in individual behaviour that might indicate a need for medical attention which if left unattended may require hospital admission. Work by Doughty and Cameron (1998) has shown that with a combination of a second generation telecare system using intelligent sensors and monitoring mobility and activities of daily living, it would be theoretically possible to monitor those variables that are most predictive of falls in older people. Using algorithms, an intelligent system at a telecare control centre could calculate the risk of an individual having a fall. However as Doughty and Cameron acknowledge, substantial data sets would be needed to validate such a falls risk index. It has also been suggested that such monitoring technology can be used to build up a picture of usual activity for a person prone to falls, which can then alert the need for help based upon unusual occurrences, e.g. an alert would not be made for someone lying on a sofa or bed, but would be made for a person lying on an area of the floor where they have not previously lain. Further, information regarding unusual or sudden inactivity could indicate other health problems that may need alerting (Nait-Charif and McKenna, 2004). Intelligent devices based on accelerometers (usually used as second-generation devices) are able to collate data on the user’s normal gait and activity, and use this to inform alerts regarding falls (Prado, Reina-Tosina and Roa, 2002).

Fuzzy ambient intelligence is an example of a third generation system where a customised sensor network is installed within a person's home (Martin et al., 2006)The sensors detect a person's movements and their use of furniture and household items, the intelligent device then analyses the movements to answer questions, such as, 'is the person eating regularly?' The system provides long-term trend patterns of the user's behaviour, to enable the intelligent system to detect any abnormal patterns of behaviour (Martin et al., 2006). Systems like this are now available such as 'ADLife' (Tunstall, 2011), which is designed as an early warning system to provide information about the person's activities of daily living with the benefits of a telecare system. The device is useful for care providers as it produces a summary of the user's data, so that even users with limited expert knowledge can analyse the data. Although as with the lifestyle monitoring systems this application has not been specifically tested for the management of people at risk of falling, this type of technology has the potential to monitor activity patterns that can be used to detect signs of a reduction in mobility or decreased activity that could be used as a trigger to the commencement of a falls prevention programme or home safety checklist. It also has the functionality to detect whether the person is taking adequate fluids and nutrition, which if they are not may precipitate a fall. The issue for consideration would be at which point this type of technology could be introduced into the falls care pathway, if at all, or whether it is an 'additional feature' for someone who already has a telecare system. Such systems often produce reports that can be accessed by carers of fallers, both formal and informal. Such people using reports submitted by ambient monitoring devices may not be experts at data analysis; therefore there is a need for reports to be easy to understand by the people likely to be reading them (Martin et al., 2006).

Ambient monitoring technologies, whilst unobtrusive in that the user doesn’t have to wear a sensor, are also limited in that there is no differentiation of individuals, although some researchers are developing algorithms to analysis the likelihood of visitors in a monitored home (Martin et al., 2006). Another avenue of data collection for third-generation systems being investigated is shoe insoles. Such intelligent shoe insoles would send data regarding the wearer’s gait to a central database. Changes in gait that are detected could be useful information to prevent a fall before it happens (Joseph, 2009). A fall detector incorporated into a walking stick has also been proposed, which would incorporate a reset button to avoid false positives being alerted. The measurement of the user’s gait whilst using the walking stick could also measure abnormalities in gait which may predict increased fall risk (Almeida, Xhang and Liu, 2007).

Generally there is little discussion within the literature about end users views on the practicality and acceptability of these technologies, though Lifestyle monitoring systems (LMS) can that can detect changes in activity that may be a precursor to an increased risk of falling have had positive reviews from carers and users. LMS typically make use of passive infrared (PIR) movement detectors in key rooms of a house that are triggered as a person moves around their home and provide a chart of activity via the internet. Data from the sensors are gathered by the controller and sent via an integral mobile phone to a web server. Family members and professionals can log on to a password protected website to view an activity chart. Lifestyle monitoring systems (like many of the second generation devices) also have the advantage that they need no input from the person who is being monitored. Porteus and Brownsell (2000) found that 80% of users were either very or fairly satisfied with the LMS and 70% thought that if they needed help the LMS would detect this and automatically call for help. Further, 64% of carers believed that the LMS was more effective than the existing community alarm system.

Use of fall detectors

With regards to studies of the use of fall detectors, in general, the majority of research into assistive technology (including fall detectors) are either case studies or qualitative in nature, and there is a lack of good quality trials (Beech and Roberts, 2008). This has been further evidenced by a Cochrane review in 2009 which found that there was a lack of good quality evidence regarding electronic assistive technologies for the home. In particular, studies are lacking the methodological detail which would allow the replication of studies and the generalisability of findings (Martin et al., 2008).

Although evidence is emerging on a small scale as reported in this review, headline findings from the Whole System Demonstrator (WSD) Project (Department of Health, 2009), the largest randomised controlled trial of telecare and telehealth in the world, indicates that telehealth can substantially reduce mortality, reduce the need for admissions to hospital, lower the number of bed days spent in hospital and reduce the time spent in A&E (Department of Health, 2011). However, the results from the analysis of the telecare data (including fall detectors) are still awaited.

One of the studies investigating fall detectors which does exist, is a survey of 2,596 community alarm users in Birmingham. Of these participants, 80% thought that the 24 hour care from the control centre was a very important feature of the community alarm service (Brownsell et al., 2000). Within the sample, 86% thought the community alarm system worked well, however Brownsell and colleagues acknowledged that this positive attitude towards community alarms may be due to the fact that participants had no alternative to community alarms to aid comparison. It should be noted however, that the community alarms used in this survey had a broad application and were not used specifically for fall detection.

A randomised clinical trial of a first generation fall detector aimed at people of 70 years of age or older who had been discharged from a hospital following a fall, found that providing people who had presented to an emergency department with a Personal Emergency Response System (PERS) did not produce any reduction in anxiety over a 30 and 60 day follow-up. However, the sample may have been biased as there were a large number of potential participants who declined to participate, and those selected for participation may not have been those who were most likely to benefit from a PERS, e.g. those with high baseline levels of anxiety (Lee et al., 2007).

A systematic review of home telecare for frail elderly people and for people with chronic conditions of 68 randomised controlled trials and 30 observational studies with 80 or more participants found that there was insufficient evidence on the effects of home safety and security monitoring in the home, for example fall detectors (Barlow et al., 2007). Despite the fact that community alarms and fall detectors are widely used they found no randomised controlled trials or observational studies that met their inclusion criteria.

Brownsell et al. (2000) found that out of a variety of telecare products, older people were most interested in the automatic fall detectors, and that they were prepared to accept technology that would support their independence. Indeed, 77% of participants who said they were fearful of falling were interested in the fall detector. A surprising result was that some participants who had fallen at least once in the past year were not interested in a fall detector and wished to cope on their own and only contact the warden in extreme circumstances. Indeed, it has been reported that older people have expressed concerns about “bothering” staff at telecare call centres, should there be a false positive activation of the fall detector (Brownsell and Hawley 2004, p.19). Brownsell and Hawley (2004) also found, via focus groups of older people, that the negative effects of false positive alerts would outweigh any benefits of a fall detector system. This is further supported by Horton (2008), who conducted a qualitative study of older people trialling fall detectors versus self activated pendants. Whilst those in the intervention group found that their waist-worn fall detectors gave them a greater sense of security, the number of false positives being reported to the telemonitoring service put off a number of the users, who felt that they had no control over the response.

Brownsell and Hawley (2004) used focus groups to access the opinions of users and professionals on worn automatic fall detectors. The users questioned the usability of the devices. Although a pendant device around the neck was preferred, a waist worn device was thought to be appropriate to raise an alarm. However, the main concern was 'bothering staff' through false alarms via accidental activation. It was found that professionals were more likely to view fall detectors negatively compared to user groups. The professionals suggested that the devices would be difficult to wear and could stigmatise the users, and in addition they suggested that the fear of false alarms would increase the user’s anxiety.

Views on lifestyle monitoring systems (mainly third-generation devices) were also mixed, with Brownsell et al. (2000) finding that 68% of residents were interested in such a system, and interestingly they were not deterred by the suggestion of a monitoring unit in the bathroom and suggested that this would have potential benefits. However, a later study by the same author found that monitoring systems were viewed with negativity, with numerous groups of participants (both users and service providers) making reference to “Big Brother”, and felt that the devices were too intrusive for some, however it was identified that such a product may be beneficial to people living alone, or people with a high fall risk (Brownsell and Hawley, 2004)**.** Demiris et al. (2005) repeated these findings with a qualitative study of home-based assistive technologies in three focus groups with older people and found that while people had concerns regarding privacy, on the whole they had a positive attitude towards assistive technology, in particular technology for the detection of falls.

Location of worn fall detectors

With regards to whether people they found it acceptable to wear a fall detector and where on the body it should be worn, a survey of older people across six different countries (Belgium, Greece, UK, Czech Republic, Austria and Spain) reported that most people would prefer to wear a fall detector sensor on the arm (41% in the Czech Republic to 100% in Greece), followed by between 20% of people in Austria and Belgium to 50% of respondents in the Czech Republic being willing to wear the sensor around the waist (Parker et al. 2008). (Parker et al. 2008) also found that older people were concerned about the requirement to wear a sensor at all times, and the constant monitoring of their movement, due to anxieties regarding invasion of personal privacy.

Wearing a fall detector

Fall detectors which require the user to wear a sensor can be problematic when the user has a cognitive impairment or dementia, in that they must remember to wear the device and use it. Further, the fall detector pendants that require the user to push a button to alert help are useless if the user is unconscious (Rougier et al., 2007). To overcome such barriers to fall detection in people with dementia, Aud et al., (2010) developed “Smart Carpets” that utilise sensors placed under a carpet to detect movement across it and can differentiate between a person standing on the carpet and a person who has fallen and is lying prone.

Another factor that can affect the wearing of fall detectors is that some worn-devices are not able to be used in areas such as the shower or bath, or areas outside the house – areas which tend to leave people at greater risk of falls (Yang and Hsu, 2009).These are areas where environmental fall detectors such as those that respond to vibration, sound or touch may need to be considered.

There are other reasons for lack of use of fall detectors including concern for invasion of privacy (Doughty, Cameron and Garner, 1996; Miskelly, 2001; Gatward, 2004). It has also been reported that some users avoid wearing their fall detector as it is uncomfortable or produces false alarms (Williams, Doughty and Bradley, 2000; Horton, 2008). Brownsell and Hawley suggested that some older people may not be inclined to adopt a product that would alert their informal and formal carers to falls, fearing institutionalisation (Brownsell and Hawley, 2004). The lack of control over whether an alert is sent has also been postulated to be a factor affecting fall detector use as users don’t want to “bother” anyone (Horton, 2008).

Demeris et al (2004) supported earlier work by Collins et al (1992) by suggesting that a fear of technology may not be responsible for a lack of uptake of technology amongst older people and suggested that older people in fact had a positive attitude towards technology. Demeris et al (2004) suggested that it is poor performance of some fall detectors and the concern people have regarding their privacy and independence which may cause a lack of acceptance of fall detector technology. However Demeris et al (2004) conceded that their research had been conducted with relatively well-educated older adults from higher income brackets who may already have positive attitudes to technology.

Further, if a person does not perceive that they are in need of a fall detector, they are then simply less likely to accept the technology (McCreadie and Tinker, 2005). Following in-depth interviews regarding assistive technology with 67 older people (age 70 and above) ,McCreadie and Tinker also found, that "*If the AT was straightforward, reliable and met a need, respondents were positive"* (McCreadie and Tinker, 2005, p. 104). This reinforces the need for good assessment processes in selecting the correct technology to meet the user's need.

Aesthetics of fall detectors

Little literature was found on the aesthetics of fall detectors; however in one study users expressed dissatisfaction regarding the aesthetics of fall detectors that they wore. Doughty, Lewis and McIntosh reported that despite 83% of older people prone to falling finding a fall sensor comfortable to wear and reassuring, 46% felt that it was too large and not a colour of their choice (Doughty, Lewis and McIntosh, 2000b).

Health and social care staff views on the use fall detectors

The views between users and health and social care staff regarding the use of fall detectors have been found to differ. For example, Durham Country Council (2002) found that whilst 60% of informal carers and 72% of users said that community alarms systems gave them more peace of mind, call centre staff were very critical of technical problems that may occur with such technology and whether problems could be easily rectified.

Brownsell and Hawley (2004) reported that fall monitoring equipment was not routinely considered in the care package for older people after a fall, and that staff knowledge of assistive devices was basic. The staff recruited in this study were also unaware of what fall detectors were, the research evidence to support their use, the target market for the devices and financial information related to the devices. Brownsell and Hawley (2004) found this surprising as the experiences and consequences of falls in the older population are high on the political agenda. However, the participants included a wide range of staff including commissioners and care provider managers and although these members of staff are part of the care planning process, they do not necessarily have in-depth knowledge of assistive technology, as it is the staff that develop the intervention care plan (the practitioners) who need the greatest level of knowledge. Their research suggested that education is needed for the practitioners who provide assistive technology to enable older people to get the correct support to continue living independently.

Hanson et al. (2007) conducted 22 focus groups in three different regions in England to explore the extent to which professionals (as well as older people and carers) consider telecare to be a potentially valuable service. They suggest that the differences in opinions they found between regions and groups were partly dependent on whether the supply of telecare services (including pendant alarms and fall detectors) is seen as a rapid response to an individual crisis or as a preventative service for access by everyone. A general lack of knowledge was felt to be an influencing factor on how valuable the service was seen to be for both older people and professionals, both groups confirming they came to the research out of curiosity and to find out more about telecare. This research raises concerns relating to the Government's ambitions for mainstreaming telecare, which may be problematic unless the misconceptions of the devices are eliminated though training and education.

Fall detectors and the fear of falling

Automatic fall detectors have been shown to reduce the fear of falling in older people (Brownsell and Hawley, 2004). Falling and fear of falling are interrelated problems: each is a risk factor for the other. Older people, who fall, regardless of whether they injure themselves, develop a fear of falling that can cause restricted activity, reduced social contact, depression and an increased risk of falling (Boyd and Stevens, 2009). In a trial of automatic fall detectors, Brownsell and Hawley (2004) reported that both the control group and the intervention group experienced a reduction in fear, as measured by the Falls Efficacy Scale (FES). The research reported positive results on the impact automatic fall detectors can have on older people's lives; 58% felt it had improved their independence, 61% considered it had improved their safety, 72% felt more confident and 90% were pleased overall with the fall detector . A further controlled study to evaluate second and third generation telecare services in older people's housing (Brownsell, Blackburn and Hawley, 2008) found that although the group allocated telecare devices showed no significant differences in their fear of falling after a 12 month monitoring period compared to the intervention group, there was a significant difference (8%) in the Social Function domain of the SF-36 (Ware and Sherbourne, 1992), suggesting a beneficial effect of telecare in this area. Positive trends were observed in the length of time spent out of the home, improved feelings of safety during the day and night and a reduction in the fear of crime. The second generation devices also detected 22 potentially dangerous and life threatening events that would not have been detected by first generation devices.

Summary

In summary, it seems that whilst there are a wide variety of fall detector technologies in development, the technologies currently available to users from statutory agencies is limited and of those new technologies under development little is published about the practicality and acceptability of the technology to end users. The literature regarding the use and acceptance of fall detectors has led some authors to suggest that items developed using universal design principles will be more likely to be accessible to all, although of particular help to those with disabilities (Swann, 2007) and long term conditions.

Carer and older people’s views of fall detectors are mixed. Whilst some are concerned with privacy, lack of human contact, user-friendliness and appropriate training, they also clearly identify that fall detectors can benefit older adults within the community (Demiris et al., 2005). Health and social care staff appear less informed and less convinced of the benefits of fall detectors.

There is insufficient evidence about the use of assistive technology in the management and detection of falls. However, it is important to acknowledge that even though there is insufficient evidence regarding the use of fall detectors, this does not mean that such interventions are without effect (Barlow et al., 2007) and it is anticipated that the results published so far from the Whole System Demonstrator trial for telehealth will also support increased used of telecare. If the direction of health and social care moves towards implementing telecare on a mainstream basis as part of the “Three Million Lives” campaign (Department of Health, 2011), it will become even more important to fully evaluate what users want from fall prevention and response services and to add to the evidence base regarding the technologies that really work in supporting older people and people with long term conditions who are prone to falls to live as independently as possible, for as long as possible in their own homes.

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