Comprehensive Scoping Study on the use of assistive technology by frail older people

Living in the Community • June 2008

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executive summary
Executive Summary

The population of Australia is ageing, and as the population ages, the occurrence of disability also increases. Around 67.5 per cent of people aged 75 years and over are affected by a disability of some kind. Assistive technology is one area with enormous potential to improve the quality of life, mobility and independence of many Australians, enabling them to continue living at home and to remain connected to their communities for longer. Assistive technology is any device, system or design that allows an individual to perform a task that they would otherwise be unable to do, or that increase the ease and safety with which a task can be performed. In combination with face-to-face individual support, assistive technology has the potential to support the independence of older people, improve their safety and security and assist them to continue living at home.

This report is a systematic review of existing published and unpublished literature relating to assistive technology for frail older people in the community care context.

Overview of findings

A major finding of this study is that while there is a large volume of literature that explores the use of assistive technology by frail older people, high quality evidence which establishes the effectiveness of assistive technology is not prolific. The literature reviewed for this scoping study did include a number of well-designed exploratory studies and expert opinions, however little research has been carried out in the Australian context.

Effectiveness of assistive technology

There is strong evidence that assistive technology can enable: improved safety and reduced falls; reduced hospitalisation; improved independence, mobility and physical function; improved well-being and quality of life, including an enhanced sense of safety and increased opportunities to continue living at home. The evidence suggests that assistive technology is most effective when older people are provided with early intervention, careful assessment, the correct prescription and home-based follow-up training in how to use assistive technologies. The research also suggests that families and carers have an improved sense of confidence about older people’s quality of life when they are provided with comprehensive telecare and/or ‘smart’ technology care.

In summary, the most effective assistive technologies identified in the literature include:

- Aids, devices and equipment to improve ease of living, safety and physical function, where they are provided early and are supported by training, maintenance and follow-up support.
- Environmental adaptations to the home, including adjusting benches, installing ramps and removing hazards to improve older people’s functional mobility and safety.
- Telecare and smart technologies to improve overall ‘peace of mind’ for older people and carers to improve safety and reduced hospitalisation and to improve quality of life and opportunities to remain at home, deferring the need to move into residential care.

There is also preliminary research available to support findings that providing computers and internet access to older people (accompanied by training and support) can improve social connection and communication. This research also suggests that computer and internet use can improve the mental and physical health of older people.

Barriers to the uptake of assistive technology

There is strong alignment between the barriers identified in the literature and the barriers identified by stakeholders interviewed for this study. These barriers include: a lack of clear access and information points for people to learn about assistive technology and be properly assessed; and the lack of follow-up home-based training and basic maintenance of technologies which is a contributor to the abandonment of aids and devices. Other barriers include poor design and unattractive appearance of aids and devices. The unattractive appearance of many items compounds issues concerning self-image, feelings of stigma and denial about disability and ageing. Many stakeholders consulted during this scoping study emphasised that the design of technologies often lacks consideration of older people’s views, attitudes and tastes. One reason for this is maybe here has only been limited research carried out involving older people both in Australia and overseas. Another significant barrier for older people is apprehension about the cost and affordability of assistive technologies.
Enablers to the uptake of assistive technology

The research indicates that the earlier assistive devices are provided to older people after an accident or incident, the more likely the person is to embrace the technology. Where service providers are able to normalise the use of assistive technology they have increased its acceptability to older people. This strategy is often described as ‘mainstreaming’. If assistive technology becomes more ‘mainstream’ its acceptability is greatly increased. The support and encouragement given by families and health professionals is also significant in older people’s decisions to use assistive technologies.

Trends in research

Overwhelmingly, assistive technology research has been carried out overseas with very little research conducted in Australia. Of all the research available overseas and in Australia, most studies are small-scale and there are a limited number of randomised controlled trials or large-scale qualitative studies. The focus of the majority of studies is on telecare, telehealth and smart technologies. More recently, there has been some preliminary research into older people’s attitudes and views on assistive technology.

Gaps in research

There are a range of gaps in assistive technology research. These gaps include the need for ongoing evaluation of the intended and unintended social impacts of assistive technology, especially in relation to the potential for older people to become isolated through increased technology use. Research about how assistive technology can improve the quality of life of people in rural and remote Australian communities is also underdeveloped in the literature. There are major gaps in research about the implementation of assistive technology services, particularly on a large-scale. There is also limited material available on the various cost models and evaluation frameworks available to quantify outcomes of assistive technology use. Concerns about the privacy and security of older people have been raised, particularly in relation to monitoring devices, although there is minimal research examining this topic. Prioritised by stakeholders involved in this study was the lack of large-scale Australian studies involving older people as consumers of technology which could further inform the evidence base.

Project limitations

This study was completed within a time limited context (approximately nine weeks in April/May 2008) which has had a bearing on the volume of literature covered. The study is intended as an initial scoping study and is not an exhaustive research project.

Excluded from the project scope was material relating to disability studies involving younger people and research in the residential care context. In addition, the focus of the study is on the ‘community care’ aspects of assistive technology, rather than its health care potential. Accordingly, remote health monitoring, i.e. telehealth is not explored in this study in significant detail.
1 introduction
1 Introduction

Australia is undergoing a major transformation in the growth of its ageing population. As the quality of health care improves, life expectancy continues to rise. In Australia, life expectancy is estimated to reach 92.2 years for men, and 95 years for women by the year 2050-51. As the population ages, the occurrence of disability also increases. Around 67.5 per cent of people aged 75 and over are affected by a disability of some kind (Australian Bureau of Statistics, 2004).

A transformation of service delivery and policy is required to meet these needs, particularly social and economic policy, infrastructure, health workforce, disability services, technology and funding. Assistive technology is one area with enormous potential to improve the quality of life, mobility and independence of many Australians, and enabling frail older people to reside at home and to remain connected to their communities for longer.

This scoping study is a systematic review of existing published and unpublished literature relating to assistive technology for frail older people in the community care context. Its purpose is to inform the Australian Government as it addresses the challenges of securing the future for Australia’s ageing population.

1.1 Assistive technology

Assistive technology is defined by the World Health Organisation as ‘an umbrella term for any device or system that allows individuals to perform tasks they would otherwise be unable to do, or increases the ease and safety with which tasks can be performed’ (World Health Organisation, 2004). This definition embodies a ‘social model’ of disability, recognising that older people’s disabilities arise ‘from the interaction between their physical and mental capacities and their environment, especially their housing’ (McCreadie & Tinker, 2005: 92). Assistive technology has the capacity to narrow the gap between an individual’s ability and their environment, either preventing or limiting the number of disruptive relocations required during old age (McCreadie & Tinker, 2005: 93).

Until recently, ‘aids and appliances’ referred to a range of community equipment designed for older people. The expression ‘assistive technology’ reflects a more modern appreciation of the growing ways technology can support the independence of older or disabled people (Audit Commission UK, 2004: 2). Assistive technology includes everything from hearing aids, voice recognition software, vision aids, mobility aids such as wheelchairs, walking sticks and crutches, systems to remember medication, adaptations to accommodation such as ramps, door opening or answering systems as well as remote monitoring systems and sensors that alert carers in emergencies. The globalisation of the technology and communications sectors has rapidly improved the range and quality of assistive technologies, with over 25,000 assistive technology devices currently available in the market place (Waldron & Layton, 2008: 62).

1.2 Australian policy context

In 2007, the Australian Government announced the assistive technology in community care measure. The initiative is designed to increase the availability of assistive technology to improve the independence of frail older people to remain safely in their homes for as long as possible. The measure has two components: Firstly, the establishment of an industry body to promote the use of assistive technology by community care providers. Secondly, the establishment of a grants program to fund commercial innovation in assistive technology from 2008-09.

1.2.1 Ageing in place

‘Ageing in place’ refers to growing old at home, without being relocated and entering into residential care. While this study is limited to frail older people living in the community (not people in residential care or younger people with disabilities), it is important to conceptualise the degree to which assistive technology relates to the overall policy context of the aged care sector in Australia. ‘Ageing in place’ is a specific objective of the broad package of reforms to the aged care system which saw the introduction of the Commonwealth Aged Care Act 1997 (Australian Institute of Health and Welfare, 2002). It aims to facilitate older people who are still relatively independent to remain in supported independent living arrangements as their support needs increase. This policy developed partly because the residential care sector was not expanding as quickly as the ageing population, and partly because older people (and their families) were reluctant to consider the need for nursing home accommodation when dependency needs were still relatively low (Australian Institute of Health and Welfare, 2002).

Assistive technology has the potential to complement existing care services that support ageing in place. There are a range of community care services currently available in Australia to assist older frail people to live...
independently in their home. Examples of these services include: Community Aged Care Packages (CACPs) which provide low level aged care in the home for people needing personal care, domestic assistance and similar services. Extended Aged Care at Home Packages (EACH) provide high-level care to people who need more help than a Community Aged Care Package can provide. Home and Community Care (HACC) aims to provide a comprehensive, co-ordinated and integrated range of basic maintenance and support services for frail older people and their carers.¹


1.3 International policy context

Interest in assistive technology is not restricted to Australia and is rapidly gaining momentum overseas. In the United Kingdom, the Royal Commission on Long Term Care completed in 1999 gave prominent recognition to the role of assistive technology in allowing people to live at home in their community. A number of other seminal reports have been released in the United Kingdom including Assistive Technology – Independence and Well-being 4 published by the Audit Commission in 2004. The White Paper Caring for People released in 1989 provided the foundation for current research into assistive technology in the United Kingdom as it promoted the values of independence and control for people during old age.

In July 2004, the UK Government announced its plans to invest £80 million in the Preventative Technology Grant (Department of Health UK, 2005: 8). The grant is to establish assistive technology in the form of telecare services across the United Kingdom to support older people to remain at home, reduce hospital admissions and improve the quality of life experienced by older people (Bowes & McCollan, 2006: 16).

The United Kingdom provides a model for the development of an assistive technology policy framework in Australia. Research relating to telecare services in the United Kingdom is featured in this report. Although only brief mention is made of assistive technology policies and developments in other countries, there is work under way to expand the provision of assistive technologies to older people in a number of countries, including the United States, Japan, China, Spain and many Scandinavian countries (Joint Improvement Team, 2008).

1.4 Conventional models of care and technological interventions

As older people age, their quality of life is increasingly dependent on the support of other people. Traditional models of care emphasise the role of family, health professionals and other carers in assisting people during old age. Population predictions bring into question the sustainability of a model of care driven by current workforce requirements. This is particularly the case considering that there will be proportionately less young people in the next few decades, and increasingly more women participating in the general workforce who may have otherwise fulfilled traditional carer roles (Australian Bureau of Statistics, 2005).

As discussed throughout this study, assistive technology does not have to be viewed as a compromise or a second preference to human care. There are a number of functions that assistive technology can provide that human care cannot, and vice versa. Most carers are not available twenty-four hours a day to prevent accidents and assist with simple daily living tasks. Many assistive technologies have the potential to relieve the burden on carers, rather than replace them. The importance of combining assistive technology with human support is an overriding theme in the literature about assistive technology for frail older people in the community and is discussed further in Section 6.2 of this study.

1.5 Projects aims and objectives

This scoping study is a systematic review of Australian and international published and grey literature relating to the use of assistive technology by frail older people living in the community. Published literature includes articles, research reports and studies published in academic and peer-reviewed journals, published government reports, research reports released by universities, and peak bodies. Grey literature includes less formal material that is publicly available including material published on the internet, government policies, non-peer reviewed articles, information pamphlets and other communications material available on assistive technology.
The key objectives of the study are to:

- determine what is currently known nationally and internationally about the use of assistive technology by frail older people in the community
- map the key concepts underpinning this area of research and the main sources and types of evidence available
- identify key trends and major gaps in the literature
- examine the benefits and disadvantages of assistive technology
- identify barriers and enablers to the uptake of assistive technology
- incorporate material recommended by stakeholders through a consultation process.

As the drive towards evidence-based practice gathers pace, scoping studies, literature reviews and systematic reviews have become increasingly important as a foundation for further research and allocation of resources, particularly in terms of identifying the risks and challenges of moving forward in a particular field.
Comprehensive scoping study on the use of assistive technology by frail older people living in the community

Method
2 Method

A systematic review was conducted using the following method.

2.1 Identification of the literature

There is a large volume of research material available in relation to assistive technology. A broad, inter-disciplinary approach was employed in this scoping study to capture a range of published and unpublished material produced in different settings. The selection protocol for research and the inclusion and exclusion criteria are included in Appendix A. The scope of the literature collected included:

- studies relating to frail older people (over 65 years)
- assistive technology that enables functional independence of frail older people
- barriers and enablers to the uptake of assistive technology
- assistive technology intended for use in primary care (at home, in the community)
- material published between 2000-2008, in English, from any location.

Also included in the project scope was material relating to the:

- social impacts of assistive technology, including the potential to increase isolation
- variability of perspective identified in the literature from the point of view of frail older people with different types of impairment or disability, carers of frail older people, allied health, professional and non-professional workforces, industry and government
- impact on resources: the extent to which assistive technology can and should replace existing human contact and services.

Literature was identified through searches of the following databases:

- MEDLINE
- APAIS HEALTH (Australian Public Affairs Information Service)
- CINAHL Plus (Expanded version of the Cumulative Index to Nursing and Allied Health Literature by EBSCO)
- HEALTH MODULE
- AMI (Australasian Medical Index)
- NATIONAL LIBRARY FOR HEALTH (formerly Public Health Electronic library)
- RURAL: RURAL and REMOTE HEALTH
- AUSTRALIAN FAMILY and SOCIETY ABSTRACTS
- AUSTRALIAN DISABILITY CLEARINGHOUSE ON EDUCATION AND TRAINING
- SOCIAL SCIENCES CITATION INDEX
- ASSISTIVE TECHNOLOGY ACT DATA COLLECTION PROJECT FOR THE NATIONAL INSTITUTE ON DISABILITY AND REHABILITATION RESEARCH (US)
- DIRECTORY OF ASSISTIVE TECHNOLOGY (US)
- PSYCHINFO
- WEB OF SCIENCE

In addition to databases searches, literature was identified through the following sources:

- a targeted internet search using ‘google.com’ search engine
- a search of key websites. (see Appendix C)
- consultation with key stakeholders (see Section 2.4).
A variety of keyword combinations were used for database and internet searches derived from the following words and terms:

- access
- age*
- applicability + transferability
- assessment
- assist*
- assistive technol*
- benefits
- ‘independent living’
- costs
- disabil*
- eval*
- ‘functional independence’
- frail aged
- older people
- global trends
- needs
- attitudes
- telecare
- telehealth
- predictors
- research
- trends
- use

- potential for increased social isolation through the use of assistive technology and ways to mitigate these impacts
- impact of assistive technology on resources and the extent to which assistive technology requires the development of a new model of care for the community care sector
- a range of viewpoints and material identified through consultation with stakeholders.

2.3 Table of evidence

Through a systematic review of the 74 studies incorporated into the narrative review, 16 studies were assessed as eligible to be included in the Table of evidence (at Appendix D). The Table of evidence identifies the quality of evidence available to support the different outcomes of assistive technology as identified in the report. Only studies that were sufficiently rigorous were included in the table. The rest of the studies are explored throughout the narrative analysis which forms the body of this report.

The 16 studies chosen were assessed using an adapted version of Rychetnik and Frommer’s (2002) schema for evaluating evidence and the NHMRC (1999) designation of levels of evidence scale. Rychetnik and Frommer’s (2002) schema for evaluating evidence on health interventions was developed in response to the difficulties associated with using evidence-based medicine methods to evaluate the effectiveness of public health interventions. Many quality or promising interventions may be rejected for evidence-based reviews because the research methods may have been observational or qualitative rather than experimental. Rychetnik and Frommer establish an approach to assessing the evidence for public health interventions that takes account of a diversity of strategies and research methods as well as contextual factors.

This schema considers evidence in the following context:

- nature of the intervention and evaluation question
- intervention context
- evaluation of intervention
- rigour of research methods
- interaction or subgroup effects
- ethical considerations
- results
- applicability of the research.
This approach allowed the studies to be ranked, compared and contrasted and makes it possible to present the information in a practical and defendable manner. This is particularly useful when making decisions about investing in areas of policy and research regarding assistive technology.

Studies were scored using the NHMRC (1999) designation of levels of evidence scale, although qualitative studies were also included in the review and noted as such. The NHMRC (1999) levels of evidence were adapted to include an additional rating (V) which refers to Expert opinion and well-designed exploratory studies.

Table 1 – Adapted National Health and Medical Research Council Designation of Levels of Evidence Scale

<table>
<thead>
<tr>
<th>Rating</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evidence obtained from a systematic review of all relevant randomised controlled trials.</td>
</tr>
<tr>
<td>II</td>
<td>Evidence obtained from at least one properly designed randomised controlled trial.</td>
</tr>
<tr>
<td>III-1</td>
<td>Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method).</td>
</tr>
<tr>
<td>III-2</td>
<td>Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case control studies, or interrupted time series with a control group.</td>
</tr>
<tr>
<td>III-3</td>
<td>Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group.</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence obtained from case series, either pre-test and/or post-test.</td>
</tr>
<tr>
<td>V</td>
<td>Expert opinion and well-designed exploratory studies</td>
</tr>
</tbody>
</table>
2.4 Stakeholder interviews

Interviews were conducted with 16 key stakeholders involved in the aged care and/or assistive technology sector. The purpose of the consultations was to provide additional information, particularly in the form of grey literature, to enhance the systematic review and to identify promising directions or initiatives being undertaken by organisations overseas and in other Australian states and territories.

The people contacted were:

- academics and researchers at Australian and overseas universities involved in research on assistive technology and/or aged care
- advisory and peak bodies, including health, ageing and disability related organisations
- key non-government organisations providing aged care services and industry organisations involved in the development of assistive technologies for older people.

The stakeholders were from a variety of backgrounds and held a range of views in relation to the future of assistive technology.

The topics discussed in the interviews included:

- the main types of assistive technologies available
- advantages and disadvantages of assistive technology
- the needs that are best addressed by assistive technology
- the main barriers faced by older adults to the uptake of assistive technology
- identification of grey literature e.g. policies and websites
- identification of high quality literature on the use of assistive technology e.g. studies and journal articles
- major gaps in existing literature and/or research.

Wherever possible the material provided by stakeholders was considered in this research project. The authors are very grateful for the invaluable contribution made by the stakeholders to the systematic review.

2.5 Project scope and limitations

The global ageing population and an increasing trend to ‘ageing in place’ have motivated the development of a vast body of literature concerning the use of assistive technology. This report is intended as an initial scoping study and is not an exhaustive research project.

As noted in the Introduction to this study at Section 1.1, there are currently more than 25,000 different types of assistive technologies available in the market place. It has not been possible to cover all of these technologies in this study. This study has been produced within a time limited context which has had a bearing on the volume of literature covered. There were approximately 9 weeks in April/May 2008 between the commencement of the project and its final submission.

Assistive technology is a multidisciplinary area of study which encompasses health care, rehabilitation, psycho-social, education, and biotechnology. It also involves examining a complex set of biological, social, and behavioural effects of interventions. This study specifically related to the use of assistive technology by frail older people in the community. Excluded from this study was material relating to:

- assistive technology and younger people with disabilities, and
- assistive technology and aged care in residential facilities.

While there was an enormous body of literature that could have been incorporated from the disability and residential care sectors, it was necessary to limit the scope of the project to the community care sector. From a preliminary scan of this broader literature, however, the authors anticipate that over the next five years the study of assistive technology and older people will merge increasingly with the field of disability studies involving younger people. A number of stakeholders indicated that the research emerging from the disability sector has considerable value as it is a well-developed area of investigation that has engaged with some of the key issues relevant to research involving older people, particularly the importance of mainstreaming, as discussed in Section 6.3.3.

It is also important to note that, to the extent possible, the emphasis of this study is on the ‘community care’ aspects of assistive technology, rather than its health care potential. Accordingly, literature relating to remote health monitoring, i.e. telehealth, is dealt with only briefly. The authors recognise the potential of telehealth technology and that it is worthy of its own research project.
Comprehensive scoping study on the use of assistive technology by frail older people living in the community

older people living in the community

3
3 Older people living in the community

3.1 Growing old gracefully

For many people, growing old is a difficult time which challenges their sense of self and personal identity. Feelings of grief and loss are not uncommon, particularly for people who have not experienced a disabling condition earlier in life and are for the first time, cognisant of their physical limitations. It was recognised by stakeholders interviewed for this study that older people are often very reluctant to identify themselves as disabled, despite their declining physical and cognitive capacities.

The literature on assistive technology highlights that many older people have strong views about the way in which they wish to experience old age. Often these views involve wanting to retain a sense of dignity, remaining in control and independent, having close social contact with friends and family, but not wanting to burden others by being physically dependent (Bowes & McColgan, 2006) (Barrett, 2008; Carr, 2006).

In Australia, there are more people beginning to confront these challenges than ever before. The increasing proportion of older people in Australian society will transform the priorities of government and social, health and aged care policy in the years to come. Figure 1 below shows predictions for population trends in Australia over the next 100 years. As indicated, the proportion of people over the age of 85 years will grow substantially before 2101. It is anticipated the next generations of older people will expect increasing flexibility and choice in services and will be more interested in being fully informed of the options for care, including self-management wherever possible (Carr, 2006: 9).
3.2 Changes to cognitive and functional abilities

As people age and their mental and physical health declines, they face new types of risks and challenges. Many older people are often unprepared for the effects of changing vision, hearing, strength, dexterity, and mobility functions. One of the most influential factors limiting older people’s functional independence is impaired cognitive abilities. Older people experience increasing vulnerability of the frontal lobes which can have detrimental effects on their executive function, planning, memory, mood and environmental awareness (TRIL Centre, 2008). Some of the consequences of impaired mental function include accident proneness, burns, forgetting to take medication and often the most problematic of all, an increased susceptibility to falls (TRIL Centre, 2008). Falls and accidents are a major cause of disability and death for people over the age of 65 years. The links between impaired cognitive functions and increased proneness to accidents and falls is the subject of a major research project at the Technology Research for Independent Living (TRIL) Centre in Ireland. The TRIL Centre has identified the two ‘geriatric giants’ of ageing to be falls and dementia, which characterise physical and cognitive disability and place substantial pressure on the health and social care systems (TRIL Centre, 2008).

3.2.1 Falls

One in three people over the age of 65 years experience at least one fall each year, resulting in at least 60,000 admissions to hospital and more than 20,000 fractured hips in 2006 in Australia (Carr, 2006: 19). Bathrooms are the riskiest places, especially where they are poorly designed and without appropriate supports. Falls can often be the catalyst for previously independent older people to begin a downward spiral in terms of confidence and physical and mental health. Many people who have experienced falls develop a type of self-imposed activity reduction that can lead to reduced strength, flexibility, contact and an overall reduction in quality of life (Carr, 2006: 19). Numerous researchers have recognised the connection between depression and functional decline. The World Health Organisation (WHO) has estimated that major depression is the fourth most significant cause of disability world-wide for people aged 65 and over (Mann et al., 2008: 9).

3.2.2 Dementia

Dementia is the term used to describe the symptoms of a large group of illnesses, which cause progressive cognitive decline in a person’s ability to remember, to think, and to learn. Dementia is the single greatest contributor to the burden of disease in Australia due to disability at older ages. Currently, an estimated 200,000 people aged 65 years and over are living with dementia in Australia, it is also the largest single contributor to the cost of care in residential aged care (Department of Health and Ageing, 2006). Dementia is one of the major reasons why older people enter residential aged care or seek assistance from community care programs. As Australia’s population ages, it is reasonable to assume that the number of people suffering from dementia will increase (Low et al., 2008).


3.3 Remaining independent, in control and socially connected

Retaining a degree of control over the ageing process is a way of mitigating feelings of disempowerment for many people. Older people have strong desires not to leave their homes and communities. This often includes their pets, which can rarely accompany them to other housing arrangements offering formal care. A United States study by conducted by Barrett involving 907 adults between the age of 65 and 98 revealed interesting trends in the attitudes of older people. The vast majority (87%) said that if they needed help caring for themselves they would prefer to have that help at their current home (Barrett, 2008: 8).

A review of literature on ‘successful ageing’ included in the study by Barrett identified many factors that contribute to peace of mind during the ageing process. Ten factors were selected and presented to the group above (907 older adults) in the United States. The two most important aspects rated by the respondents were being in good health (96%) and having the ability to do things for myself (95%) (Barrett, 2008: 10).

Other aspects rated highly were: having friends and family there for me (83%), feeling safe and secure (82%), having the freedom to do what I want (82%), being able to deal with whatever life brings (81%), having enough money to meet my needs (79%), staying involved with the world and other people (66%), being able to enjoy
physical exercise (63%), continuing to learn new things (57%) (Barrett, 2008: 10).

When asked how satisfied they were with each of these aspects of their lives the respondents consistently rated their satisfaction lower than the importance they attached to it. Figure 2 below compares the level of importance attributed to each aspect with the level of satisfaction experienced by the group.

**Figure 2 – Level of importance and satisfaction with successful ageing values among those aged 65+**

[Graph showing levels of importance and satisfaction]

Source: (Barrett, 2008: 10)

The study also found that older people who do not have a condition that substantially limits one or more basic physical activity, such as walking, climbing stairs, reaching, lifting or carrying, were far more likely to be satisfied with the aspects of their life described above. Similar results were established in relation to cognitive abilities. The older people who said they did not have problems with learning, remembering and concentrating, reported being much more satisfied with each aspect of their life as described above (Barrett, 2008: 11).
3.4 Significance of the built environment

As people grow old the gap between their abilities and their environment creates previously un-encountered obstacles to daily living. The built environment has a particularly important impact on whether older people are able to remain in their homes and ‘age in place’. Often older people live in environments that are poorly matched to their abilities and create environmental barriers and hazards. Steps and stairs create difficulties, hallways can be too narrow and unsafe and the housing itself can create a disability. Some authors have described these circumstances as creating an ‘architectural disability’ (Hanson, 2001), (McCreadie & Tinker, 2005: 93).

3.5 Mainstreaming notions of disability and care

The importance of mainstreaming notions of disability and care is emphasised in the literature about ageing and assistive technology. The United States Assistive Technology Act 1988, captures the move towards mainstreaming perceptions of disability in its declaration that; ‘Disability is a natural part of human experience and in no way diminishes the right of individuals to live independently; enjoy self-determination and make choices; benefit from an education; pursue meaningful careers; and enjoy full inclusion and integration in the economic, political, social, cultural, and educational mainstream of society.’ This approach promotes the idea that all people can enjoy a healthy and active life regardless of their limitations.

In 2001, WHO developed a framework for understanding notions of health and disability in a new light. The International Classification of Functioning, Disability and Health (ICF) developed by the WHO recognises that every human being can experience a decline in health and physical ability, thereby experiencing some kind of disability. The ICF’s classification embraces new concepts of social inclusion, emphasising the importance of all people in participating in as many facets of human existence as possible (Walker, 2007). A socially inclusive model of care is made possible by strategies to mainstream disability and care. Initiatives designed to do this have been particularly effective in increasing the uptake of assistive technology overseas. Specific examples of these initiatives are discussed in Section 6.3.3 of this report.

This study is informed by the principles explored above. These principles include the importance of promoting social inclusion, providing support to older people to participate in society and helping all older people to maintain active and healthy lifestyles wherever possible.
overview of types of assistive technology
4 Overview of types of assistive technology

Assistive technology encompasses a large number of technologies, ranging from low-tech daily living supports, such as walking frames and non-slip bathroom mats, to high-tech integrated systems which involve remote monitoring sensors designed to alert an appropriate person when someone has fallen or has not taken their medication.

There is no universal framework in the existing literature used to categorise the range of assistive technologies available. A number of authors have recognised the difficulty of benchmarking assistive technology research because of a lack of standard international definitions (Joint Improvement Team, 2008: 7). In order to convey the range of user needs currently supported by assistive technologies, the types of technologies have been grouped into four key categories:

1. aids, appliances and equipment
2. environmental adaptations
3. remote monitoring devices, and
4. integrated systems.

In this typology, many traditional assistive technologies, such as ‘daily living’ aids, mobility aids and sensory aids - whether low-tech or high-tech, are subsumed into the broad category of ‘aids, appliances and equipment’. Currently, the most widely used and available types of assistive technologies in the community fit into the first category. More recently developed technologies, often appropriate for people in need of more comprehensive care, are likely to fall within the latter categories. The organisation of assistive technologies in this way makes it possible to view these technologies as interventions along a continuum of care as seen in Figure 3 in Appendix B.

The purpose of this section is to map the various technologies referred to in the literature. Only brief detail is provided about aids, appliances and equipment, as most people have some degree of familiarity with this area. Monitoring devices and integrated systems are less familiar territory. More detail is provided about these technologies as they are complex interventions which are relatively new to the marketplace. The assistive technologies described in this section are summarised in Table 2 below.

Table 2 – Types of assistive technology

<table>
<thead>
<tr>
<th>Category of Assistive Technology</th>
<th>Types of Assistive Technology</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aids, Appliances and Equipment</td>
<td>‘Daily living’ aids</td>
<td>Reachers, bath seats, non-slip mats, handles, jar openers</td>
</tr>
<tr>
<td></td>
<td>Mobility aids</td>
<td>Wheelchairs, vehicle conversions</td>
</tr>
<tr>
<td></td>
<td>Communication and sensory aids</td>
<td>Hearing aids, speech output devices, large print screens, telephone amplifiers</td>
</tr>
<tr>
<td></td>
<td>Cognitive and connectivity aids</td>
<td>Computer and internet access, specially designed user interfaces, matching reasoning aids, ‘talking word processors’</td>
</tr>
<tr>
<td>Environmental adaptations</td>
<td>Environmental switches and controls</td>
<td>Remote control of doors, windows, locks</td>
</tr>
<tr>
<td></td>
<td>Home modifications</td>
<td>Principles of inclusive design, modifying risky areas including bathroom, kitchen, installation of reinforced grab rails</td>
</tr>
</tbody>
</table>
4.1 Aids, appliances and equipment

4.1.1 ‘Daily living’ aids

‘Daily living’ aids is a broad title that refers to a relatively small number of assistive technologies. The title is most often used to describe self-help devices that support a person in dressing, personal hygiene, bathing, home maintenance, cooking and eating. These aids are usually relatively low-tech and essentially make daily tasks easier. Examples include reachers, bath and shower seats, long shoe horns, handles and aids to manage medications. Sometimes these devices are described as ‘personal aids’.

Examples of how automatic sensors and monitoring systems can provide better safety and security in the home is detailed in Section 4.3.1 onwards. This discussion includes sensors that provide automatic lighting for older people at night when they move around the house. It also enables a person to view on a small screen who is outside their front door.

4.1.2 Safety aids

This category includes both household and personal safety aids. Examples of household safety aids include non-slip mats, grab bars and grips. Personal safety aids include basic alarm pendants that can be worn at all times. Recently, technology assisting with home safety and security has been developed in the telecare context.

4.1.3 Mobility aids

These aids assist mobility impaired persons to move safely within their environment and to give them independence and personal transportation. They include everything from walking sticks and frames (also known as ambulation aids) through to wheelchairs, scooters, power chairs and vehicle conversions. Modifications to regular chairs, wheelchairs, or devices that help people get up and down unaided by a carer and/or that help reduce pressure on the skin, may also fall within this category.

4.1.4 Communication and sensory aids

Communication is the core of all social interaction, without which a person’s mental and physical state rapidly declines. The interrelatedness of these factors is reflected in the literature and is explored further at Section 5.4. A number of devices exist to assist the communication capacities of older people. Sensory aids include a range of sophisticated devices for vision and hearing impairments, such as hearing aids, Braille and speech output devices, large print screens, and visual alerting systems such as flashing lights to replace

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**Table 2 – Types of assistive technology (continued)**

<table>
<thead>
<tr>
<th>Category of Assistive Technology</th>
<th>Types of Assistive Technology</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Monitoring devices</td>
<td>Telecare</td>
<td>First level telecare – alarm pendant connected to 24 hour monitoring centre</td>
</tr>
<tr>
<td></td>
<td>Telehealth</td>
<td>Second level telecare – including bed sensors, medication reminder systems, fall monitors, gas monitors, flood monitors, ‘wander’ and motion monitors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Third level telecare - ‘Remote consultation’/ virtual visiting, monitoring of vital signs, blood pressure check, temperature, respiration, pulse, weight</td>
</tr>
<tr>
<td>Integrated systems</td>
<td>Smart homes, Age Friendly homes</td>
<td>Integrates telecare, electronic assistive technologies and environmental controls. Involves technology that learns behaviour and reacts to needs</td>
</tr>
</tbody>
</table>
doorbells. Other communication aids include voice recognition technology, writing and typing aids and telephone amplifiers.

A whole area of communications technology is devoted to Augmentative and Alternative Communication (AAC), relevant to an older person recovering from a stroke. AAC assists people who have impaired speech and writing abilities by providing an alternative method of communicating needs, feelings, ideas and perceptions through electronic and non-electronic devices. Examples include communication boards, speech synthesisers, text-to-speech software, head wands, mouth sticks and telephony equipment.

4.1.5 Cognitive and connectivity aids

A multidisciplinary approach to assistive technologies incorporates aids and devices that maintain essential cognitive functions and facilitate social connectivity among older people. This includes software that focuses on categorisation, matching association, reasoning, decision-making skills, problem solving, memory skills, perceptual skills, ‘talking word processors’ and cognitive retraining. Where appropriate to the person, computer access aids and adaptations enable older people to continue using computers. Often cognitive aids work in combination with social connectivity technologies. Moves towards building social connectivity aids into assistive technologies are occurring as a result of research which reveals that internet use has positive functional and mental health effects on older adults (Malcolm et al., 2001).

4.2 Environmental adaptations

Adaptations to the built environment can assist older frail people and mobility impaired persons to interact more effectively with their environment. Environmental controls and switches require some alteration to the person’s home so that they are able to electronically manipulate various aspects of their environment, such as the telephone, television, doors, air conditioner or locks, by activating a device similar to a television remote control.

The principles of inclusive design are an important aspect of assistive technology. Home modifications are commonly made to the bathroom and kitchen as they present the greatest risks for falls and accidents as people age. Widening hallways, replacing stairs with ramps, installing reinforced grab rails and raising toilet seats can have significant impacts on personal safety and quality of life (see Section 5). Moves to make the principles of inclusive design standard in the construction of new housing have been encouraged by the disability sector, and will undoubtedly grow as the ageing population increases.

4.3 Remote monitoring devices

Electronic monitoring systems have taken the field of assistive technology in new directions. Personal monitoring systems, such as blood pressure and heart rate monitors have been around for some time. This section focuses on remote monitoring, particularly ‘telecare’ and ‘telehealth’, as they have received substantial government funding in a number of countries including the United Kingdom, Scotland, Ireland, Spain, Italy, the United States and many Scandinavian countries (Joint Improvement Team, 2008: 8). Numerous stakeholders interviewed in this scoping study emphasised the enormous potential of telecare and telehealth to add to the quality of life of older people and to reduce the burden on the health and community care sector.

A number of local authorities in the United Kingdom currently use telecare as part of an intermediate care service. Patients’ homes are fitted with a telecare package on discharge from hospital. To complement this, they receive regular visits and calls from care staff and community alarm service providers. The service is provided free of charge for six months and has been very popular with patients (Department of Health UK, 2005: 12), (Audit Commission UK, 2004: 19). The Montedonini Aged Care Service in Florence, Italy is a major care provider in the Tuscany region which has gone directly to the marketplace to seek an electronic home care system. The French telecommunications company Alcatel has since installed a system that connects 500 homes via Montedonini’s 24 hour call centre. The service is thought to be successful because it uses technology familiar to older people, such as the television and the telephone (Soar, 2008: 24).
4.3.1 Telecare

Telecare is the remote or enhanced delivery of services to people in their own home by means of telecommunications and computerised systems (Joint Improvement Team, 2008: 4). Telecare ranges from basic community alarm services to more complex interventions involving fall detectors and sensors which monitor a range of physical behaviour. Some authors have usefully divided telecare into first, second and third level care (Joint Improvement Team, 2008), as summarised in Table 3 and described in further detail below.

Table 3 – Levels of telecare

<table>
<thead>
<tr>
<th>Telecare</th>
<th>Comment</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>First level care</td>
<td>Telecare is a mainstream form of care service provision in many countries, including Spain, Scotland and parts of England. (Joint Improvement Team, 2008).</td>
<td>The basic or first level of telecare involves a user-activated water-proof pendant that a person wears around their neck at all times. In the event of an emergency the person presses the button and it dials the number of a 24 hour response centre. The person can organise an appropriate response depending on their situation, i.e. an ambulance, visit from a friend, family or carer. VitalCall is an example of this type of service operating in Australia (<a href="http://www.vitalcall.com.au">www.vitalcall.com.au</a>).</td>
</tr>
<tr>
<td>Second level care</td>
<td>This technology is often used in ‘smart’ homes</td>
<td>Second level telecare is the incorporation of sensors into the home that monitor the environment, for example, smoke and gas detectors, bed occupancy sensors, passive infrared sensors connected to doors to indicate when a person has left the house.</td>
</tr>
<tr>
<td>Third level care</td>
<td>Also known as ‘e-Health’, ‘telehealth’ or ‘telemedicine’.</td>
<td>Third level telecare is also known as telehealth or telemedicine. Telehealth offers the potential for virtual or tele-consultations between an older person and their doctor, nurse or support worker. It reduces the need for home visits, hospital appointments and also enables a person to return home sooner after a hospital stay.</td>
</tr>
</tbody>
</table>

Source: Summary compiled by Urbis utilising the categories developed by the Joint Improvement team, 2008.
First level telecare

Basic telecare services, comprising an alarm pendant linked to a 24 hour monitoring service, are a mainstream form of care service provision in many countries including Spain, Scotland and parts of England. Similar technology has been available since the Second World War. There are now more than 1.4 million users in England who are connected to a telecommunications network linked to people at call-centres able to provide assistance (Department of Health UK, 2005).

Second level telecare

Second level telecare is the incorporation of sensors into the home that monitor the environment, for example, smoke and gas detectors, bed occupancy sensors, and passive infrared sensors connected to doors to indicate when a person has left the house. These sensors are linked to a 24 hour monitoring centre which notifies carers or provides an emergency response. Signals are received by a desktop computer and multi-channel wireless receiver which analyses data. The analysed results are then transformed into an electronic report and sent back to the centre through the telephone line by a modem. This enables care to be provided without requiring other family members and care providers to be home all the time (Tong & Wong, 2005). Automatic fall detectors are often used for older vulnerable people, such as older people experiencing the onset of dementia, and those at risk of seizure.

Household safety and security

There are a number of sensors designed to improve household safety and security. Typical examples of sensors that can be installed in the home as part of a telecare package are provided in Table 4 below adapted from (James, 2006) and (Dunk & Doughty, 2006).
### Table 4 – Sensor types

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video door bell</td>
<td>Allows visual confirmation of visitors and remote door access into a property - giving both security and assistance to the people who live there. Older people are able to view who is outside via their television or a small screen next to the front door.</td>
</tr>
<tr>
<td>Smoke detectors</td>
<td>Smoke detectors operate with a normal alarm signal within the home and have wireless data transfer capabilities to send the alert to a monitoring centre. If the service user is able to understand instructions they are directed to check whether it is a false alarm, otherwise the fire brigade is called.</td>
</tr>
<tr>
<td>CO₂ Monitor</td>
<td>This sensor monitors elevated levels of CO₂. If the service user is able to understand and follow verbal instructions they are advised to switch off gas appliances and open windows. Alternatively, an emergency response is provided.</td>
</tr>
<tr>
<td>Flood detectors</td>
<td>Flood detectors monitor the bathroom and kitchen floors for water. They trigger an alarm call within the home and send an alert to the monitoring centre. If the service user can respond to instructions they are directed to switch off taps in the bathroom/kitchen and to be careful about slipping.</td>
</tr>
<tr>
<td>Extreme temperature</td>
<td>These detectors are capable of providing an alert if there is extreme heat, such as from a stove being left on. These detectors monitor high and low temperatures so they can detect the risk of fire and the risk of hypothermia.</td>
</tr>
<tr>
<td>Passive infrared detectors</td>
<td>Intruder detection is provided by two passive infrared (PIR) detectors. The detectors can raise an alert within the home or, if there is a reason to avoid alerting the intruder, they can operate silently and transmit the alert to the monitoring centre. The detectors can also be programmed to raise an alarm in the event of prolonged periods of inactivity.</td>
</tr>
<tr>
<td>Epilepsy alarm</td>
<td>This is a sensor for people who may have an epileptic seizure in bed. It detects rapid movements and transmits an alert to a carer or the monitoring station as desired.</td>
</tr>
<tr>
<td>Gas Cooker Monitor</td>
<td>The control turns off the gas when the food being cooked reaches a certain temperature. This has no effect when the cooker is used the next time.</td>
</tr>
<tr>
<td>Bed occupancy detector</td>
<td>This device monitors a person’s bed occupancy at night and can trigger an alarm according to pre-set exception rules (for example, if a person gets out of bed at night and does not return within a period of time).</td>
</tr>
<tr>
<td>Enuresis or bed wetting sensor</td>
<td>A sensor which can monitor bed wetting will alert a carer when timely intervention and/or support is required.</td>
</tr>
<tr>
<td>Remote/ automatic control of lighting</td>
<td>Lighting can be controlled by means of infrared or wireless remote controllers. Lighting can be switched on automatically by an activator, when a person gets out of bed at night to light the way to the toilet. It automatically switches off the lights on return to bed.</td>
</tr>
<tr>
<td>Activity monitoring</td>
<td>Miniaturised sensors can be used to monitor activities, such as things like turning on taps, walking, etc. Data can be used to identify trends in behaviour, for example, declining mobility. Sensors can be used to automatically turn taps or stoves off.</td>
</tr>
<tr>
<td>‘Wander’ detector</td>
<td>A wandering detector monitors a person’s entry/exit door during a pre-set period when the user may be at risk. If the sensor is triggered, for example, at 2:00 am, a carer or the monitoring service would be alerted that the door has been opened. A wander monitor is designed to make it considerably safer for someone with dementia to remain living in an extra care unit or at home.</td>
</tr>
</tbody>
</table>

Source: Adapted from James, 2006 and Dunk & Doughty, 2006.
4.3.2 Telehealth

Third level telecare

The terms ‘e-Health’, ‘telemedicine’ and ‘telehealth’ tend to be used interchangeably to refer to third level telecare services. Telehealth is considered a more accurate expression and so will be used throughout this scoping study (Audit Commission UK, 2004: 1). Telehealth has developed from improvements in the availability of broadband, wireless and audio-visual technology. It enables a clinical assessment to be carried out remotely and works by monitoring vital signs, such as blood pressure and heartbeat. Telehealth technology transmits data to a response centre or a clinician’s computer where it is monitored against parameters suitable to the patient’s condition. When the computer receives evidence that is outside the normal parameters of the patient’s condition, it triggers a response (Department of Health UK, 2005: 9). Telehealth is not intended as a substitute for health care services, but it can reduce the frequency of check-ups required by people with long term conditions.

Although telehealth is usually considered ‘responsive’ in nature, it has significant preventative aspects. It can enable clinicians to detect risks before serious incidents occur. Telehealth technology has been shown to be particularly useful in assisting long-term health care options for people affected by chronic obstructive pulmonary disease, congestive heart failure, hypertension, asthma and diabetes (Audit Commission UK, 2004: 23).

New technologies are making telehealth monitoring less obtrusive. The Don Gnocchi Foundation in Milan, Italy has developed a washable Smart Vest with embedded sensors that monitor and transmit vital signs and spatial positioning. The Collaboration for Ageing and Aged-Care Informatics Research (CAAIR) based at the University of Southern Queensland has reached an agreement with Don Gnocchi to trial the vest in Australia (Soar, 2008: 23).

4.4 Integrated systems

Integrated systems are home care arrangements that combine a number of kinds of assistive technologies. There is considerable overlap between integrated systems and second and third level telecare services. The sensors described in the table above are often built into integrated systems, often described as ‘smart housing’. Smart homes incorporate monitoring systems, modifications to the built environment, electronic controls, automatic stove and tap shut offs. These services are complex interventions involving hybrid technology and people-based services provided to a varied client base with wide-ranging needs (Williams & Doughty, 2007: 42). For a proportion of people, these arrangements may provide a genuine alternative to residential care.

Internationally and in Australia, there are a number of pilot studies being carried out to explore the utility of comprehensive assistive technology packages to enable older people to remain at home longer. These studies claim to make significant impacts on older people’s safety and quality of life (as discussed in Section 5). Although there is an initial outlay, the cost savings in terms of human services reported from these arrangements are significant (see Section 5.2.3: Prevention of Hospitalisation). An example of an integrated system, the Smart Home, is provided below.

4.4.1 Smart homes/Age friendly homes

Once telecare systems, electronic assistive devices and environmental controls are integrated, the whole system is sometimes described as ‘smart housing’ (Audit Commission UK, 2004: 18). Although smart housing or smart home technology is not part of mainstream service provision, it is being used in a number of countries to meet the needs of some frail older people with particularly complex care needs who have a strong desire to remain at home. These countries include the Netherlands, Spain, Italy Norway and the United Kingdom (Cash, 2003), (Joint Improvement Team, 2008: 10). Smart home technology is also being used in some parts of Australia (see Section 5.5.1).

Smart housing is particularly appropriate for older people experiencing the onset of dementia because many smart home technologies are passive and do not rely on the resident to remember what the aids are or how to use them (Cash, 2003: 313).
Most studies relating to smart housing involve older people with dementia. The key feature of smart home technology is that rather than simply monitoring behaviour and notifying an external carer or emergency response team, smart home technology provides automated responses to assist the person as needs develop. This is made possible via automatic equipment, verbal prompts and reminders. If a person wanders at night it can provide low level lighting to guide them to the bathroom.

All assistive technologies, whether telecare, telehealth or smart technology, need to balance technology with other forms of care and support. Many stakeholders involved in this literature emphasised the importance of the care team in making these types of technologies work. The importance of the care team in ‘closing the loop’ is a strong theme in this report. It is discussed further in the section relating to ‘barriers and enablers to assistive technology’ at Section 6. Opposite is a case study by Evans et al. illustrating the key features of smart home technology.
Case Study 1 – The Enabling Smart Flat in Deptford, London

The tenant was 82 years old and was diagnosed with moderate/severe vascular dementia. He had impaired vision and diabetes. He experienced the onset of dementia over a period of four to five years and had previously lived alone in the community with support from his family and care services. At the time of moving to the smart flat his mood was depressed and he was incontinent of urine. There was concern about his ability to care for himself and about the risks of him wandering throughout the night. He no longer cooked for himself.

The enabling smart flat had sensors installed that monitored activity, bed occupancy, night-time wandering, going outside, use of cooker and taps. It had automatic shut-off systems for heat, flood and gas. It could also analyse data about night-time restlessness and staff could be alerted when a problem arose. A multidisciplinary care team was involved in the design and on-going monitoring of the flat. For the first 10 weeks the technology was programmed only to learn the behaviour of the tenant and not react. It was immediately clear that the tenant was not getting enough sleep as he was in and out of bed all night. This had not been identified in his previous assessments, which surprised family and staff. In addition, (despite what he had told his family), he regularly used the stove, even during the night.

After ten weeks the technology was turned on. Low-level automatic lighting would guide him to the bathroom during the night and assist him to return to bed. Based on sensor data it was clear that further support was needed. Voice prompt software (with recordings of his daughter’s voice) was used to encourage him to go back to bed. If he failed to return to bed after 30 minutes, care staff were called. The outcomes of the smart flat were considered positive for the tenant. On most occasions he responded to voice prompts to return to bed. His levels of sleep rose significantly from around three hours to six hours per night. His continence also improved. The quality of life for the tenant improved and his daughter was greatly relieved about the level of care he received.

Source: Evans et al., 2007.
how assistive technology can support older frail people in the community
5 How assistive technology can support frail older people in the community

This chapter briefly reviews the overall quality of literature available before identifying four important functions supported by the use of assistive technology for older people. These are:

- safety and prevention
- ease of living, mobility and independence
- social connectivity and preserving cognitive abilities,
- well-being and quality of life

5.1 Quality of evidence available

High quality evidence which establishes the effectiveness of assistive technology in the community care context is not prolific, despite the vast amount of material published in this field. It is noteworthy that through a systematic review of evidence, only 16 studies were assessed as having a sufficient level of rigour to be rated according to the NHMRC (1999) designation of levels of evidence scale and included in the Table of evidence at Appendix D. Where there is a particularly high quality study available to support a finding, such as a systematic review or randomised controlled trial, these studies are noted throughout the following sections. In relation to more ‘traditional’ assistive technologies, such as aids, appliances, equipment and environmental interventions, there are some systematic reviews and randomised controlled trials available. Research relating to more recent technologies, such as telecare and telehealth is composed primarily of pilot studies, expert reports, case studies, non-experimental descriptive studies and some large-scale survey-style reports.

Some authors have noted that the production of high quality evidence about the effectiveness of assistive technology is complicated by the difficulty of developing comparable outcome measures. Quantifying telecare benefits is also challenged by the complex client base and wide-ranging social capital involved, particularly the varying levels of personal and family support available to older people (Joint Improvement Team, 2008: 13). Although recently it has been argued that the evidence for assistive technology, such as telehealth, is well established (Ayyagari, 2008), other authors note the lack of high-quality evidence in the form of randomised controlled trials (RCTs) for more general assistive technologies, even for commonly prescribed equipment such as bathing and toileting aids (Lovarini et al., 2006). The identification of this gap in high quality evidence by Lovarini et al is significant because it was established through a systematic review of all studies relating to assistive technology between the years 2000-2005.

5.2 Safety and prevention

Safety is consistently identified in the literature as one of the most important reasons for the use of assistive technology, (Mann et al., 1999), (Kentta et al., 2007), (McCreadie & Tinker, 2005). Numerous authors identify the safety aspects of assistive technology in the context of broader research projects. These authors include McCreadie & Tinker (2005), Dunk & Doughty (2006), Bowes & McColgan (2006), Audit Commission UK (2004), and the Joint Improvement Team (2008).

Other studies have made specific findings about the safety aspects of assistive technology. A study carried out by Kentta et al, found that safety was considered the most important reason for developing technology-based service solutions to support independent living for older people in Lyon, France. The research involved a ‘user assessment study’ in which six different service scenarios were created and analysed in six focus groups involving young adults, elderly people and health-care professionals. The particular technologies involved in the study included remote monitoring technologies such as telecare and telehealth. The study found that older people and health professionals generally preferred scenarios that included safety features or emphasised communication possibilities (Kentta et al., 2007).

A survey carried out by Roelands et al found that the most highly valued outcomes in terms of the performance of assistive technologies were increased safety and autonomy, followed by efficiency. The survey involved a representative sample of 491 community-dwelling elderly people in Flanders, Belgium, aged between 79 to 89 years. Almost all devices covered by the survey were ‘low-tech’ such as bath seats, support rails, adjustable bed supports and personal alarm systems. The purpose of the study was to provide insight into the contribution of psychological variables in
understanding the use and non-use of assistive devices for self-care and mobility. The authors developed a social-cognitive model of behaviour to explain the use of assistive technologies, (Roelands et al., 2002: 45-46).

5.2.1 Increased sense of safety

Some authors have found that an increased feeling of safety has a positive impact on the mental health and well-being of some older people. Adaptations to housing, including the installation of reinforced grab rails, provision of non-slip mats and basic alarm systems have been effective in increasing feelings of safety among older people. In a study reported by Heywood & Turner, older people described increased feelings of safety by 70 per cent after adaptations to their houses were made (Heywood & Turner, 2007).

Another study conducted by Heywood also found that minor adaptations (specifically grab rails and handrails) produced lasting positive consequences for almost all of the older people involved in the study:

- 62 per cent of respondents indicated that they felt safer from the risk of an accident, and
- 77 per cent perceived the adaptations to have a positive impact on their health.

The study also found that major adaptations (including bathroom conversions, extension and lifts) had ‘transformed’ people’s lives, motivating them to view their life circumstances more positively, by describing themselves as ‘independent’, ‘useful’ and ‘confident’. The average score out of ten awarded to these major adaptations by the older people involved in the study was 8.9. The findings of the study were primarily based on direct interviews with 104 recipients of major adaptations and 162 postal questionnaires returned by recipients of minor adaptations. The study by Heywood provides the first large-scale study of the outcomes of public expenditure of £250 million a year on housing adaptations in England and Wales. The research is the product of a partnership between housing and occupational therapy professionals and researchers and is based on interviews in seven local authorities in England and Wales (Heywood, 2001).

Importantly, a study conducted by Sveistrup et al. carried out in Canada found that the perceived usefulness and safety of bathroom modifications varies considerably depending on how bath rails are configured, and on the official standard to which they conform (Sveistrup et al., 2006).

In a study published by the AARP Foundation in the United States involving 907 adults over the age of 65 years, there was widespread agreement that using home safety devices made the participants feel safer (85 per cent), and gave them more personal peace of mind (78 per cent) as well as that of their friends and family (82 per cent). The respondents also agreed that home safety items would make them feel more comfortable (76 per cent) and be something they can rely on (72 per cent) (Barrett, 2008: 17). This study was assessed as being sufficiently rigorous to be included in the Table of evidence at Appendix D, although it was a given rating of (V) indicating that it is evidence obtained from a well-designed exploratory study, rather than a randomised controlled trial or systematic review.

A small controlled study conducted by Brownsell et al. of older people living in sheltered housing (retirement housing) in the United Kingdom, found that providing telecare services to older people had positive impacts including improved feelings of safety during the day and night and a reduction in fear of crime. Twenty-four people were provided with telecare services and were compared with a control group of 28 people. The study involved four different types of telecare packages and participants could select one or more. These packages were:

a. security package: front door remote access with closed circuit television (CCTV) camera (viewed on their own television screen), intruder alarm, flood detectors and extreme temperature detectors
b. falls package: fall detectors and automatic light switches
c. specialist devices: wandering client system (alert if the front door is opened at night), epilepsy bed monitor, strobe light alert, vibrating pillow alert
d. lifestyle reassurance: bed and chair occupancy devices, movement detectors, door contact monitors and electrical usage – (third generation system).

The authors of the study collected baseline data on the participants involved and then installed the telecare packages over a two month period. The authors of the study concluded from the qualitative data collected that the intervention group spent more time out of the house and had improved feelings of safety. Interestingly, the study found no change in the respondents’ fear of falling. Brownsell et al suggest that the sample size of the study may have been too small to make conclusive findings in this area (Brownsell et al., 2008).
5.2.2 Prevention of falls

Some authors have measured the safety aspects of assistive technology by its potential to reduce falls. The Canadian Government has developed a Best Practices Guide for the Prevention of Falls Among Seniors Living in the Community which is based on a systematic review of studies evaluating the effectiveness of fall prevention strategies for community-dwelling seniors (see Scott et al., 2001). This study received the highest rating (I) in the Table of evidence included in Appendix D. The Best Practices Guide identifies environmental modifications as an important strategy to reduce falls. In setting out best practice in relation to home modification, it makes a number of findings set out below:

- The success of home modification programs may be enhanced when combined with other strategies such as education and counselling on how to reduce behavioural and physical risk factors that increase the risk of falling.
- Successful home modification programs often included those with financial and/or manual assistance in completing the modifications.
- Occupational therapists’ training and skills make them ideal professionals for conducting home assessments as they are able to assess both the seniors’ environment and their ability to function within that environment.
- Success and cost effectiveness of environmental strategies are enhanced by targeting those who are ready for change.
- Readiness for environmental modifications may be linked to having had a recent fall, and/or an increased understanding of the risks and prevention strategies.

Importantly, the Best Practices Guide also concluded that only very large studies can detect differences in fall-related injuries. Although it may be expected that a reduction in falls would lead to a reduction in fall-related injuries, the Best Practices Guide found very little evidence to support this conclusion one way or another. The systematic review also found that monitoring falls among community-dwelling seniors is very difficult as most studies rely on self-report methods of monitoring. The authors of the study concluded that this would lead to an under-reporting of falls (Scott et al., 2001).

The Joint Improvement Team, established in late 2004 to work directly with local health, social care and industry partnerships across Scotland has published valuable information on role of assistive technology in preventing negative events, such as falls. One of the initiatives described by the Joint Improvement Team is the Falkirk Falls Management Program in Scotland. The program has been particularly effective in responding to falls. It is a collaborative initiative between care workers and primary and secondary health workers. Mobile emergency care staff monitor for and respond to service user falls. If a service user experiences more than one fall they are offered assistance through the Falls Management Clinics, which are operated by a multidisciplinary team providing assessment, equipment, advice and therapy services. Since the service was established, mobile emergency care staff have attended over 8,000 falls, and almost 300 people have been offered a referral to the Clinics. Automatic fall detectors are now part of mainstream service provision for older people with dementia, and older people at risk of seizure in Scotland (Joint Improvement Team, 2008: 4). Home visits by occupational therapists or trained volunteers to assess and modify environmental risks have also been effective in preventing and reducing falls (Centre for Reviews and Dissemination, 1996: 2).

5.2.3 Prevention of hospitalisation

The prevention of hospitalisation is another outcome used in the literature to measure the safety potential of assistive technology. Assistive technologies can reduce the occurrence of events requiring hospitalisation and reduce the length of hospital stays (Dunk & Doughty, 2006), (Beswick, 2008: 9). More complex telecare and smart technology interventions have significant safety and preventative advantages made possible through early identification of risks by gas detectors, fall monitors, stove guards and other monitoring systems which address problems before they escalate into serious accidents requiring hospitalisation (Evans et al., 2007), (Dunk & Doughty, 2006), (Department of Health UK, 2005), (Audit Commission UK, 2004: 20). This reduction can lead to significant cost savings for governments.

Since 2006, telecare services in Scotland funded through the Telecare Development Programme have resulted in:

- Approximately 1,300 additional people able to maintain themselves at home with support
- 66 delayed hospital discharges and 140 emergency hospital admissions avoided, with 1,800 hospital bed days saved
- 74 care home admissions avoided, and 6,900 care home bed days saved
- 1, 250 nights of sleepover care and 107, 000 home check visits saved (Joint Improvement Team, 2008: 2).
The York Health Economics Consortium has provisionally estimated approximately £2.9m has been saved in Scotland as a result of these services (Joint Improvement Team, 2008: 2).

A study reported by the United Kingdom Audit Commission involving over 100 users of telecare found that following the introduction of the service, there was a 25 per cent reduction in the number of hospital admissions and the average length of hospital stays was reduced from 9.2 days to 5.7 days (Audit Commission UK, 2004: 20). The UK Audit Commission has published estimates indicating that telecare can replace the need for hospitalisation in 5 to 15 per cent of patients aged 70 years and over. The average length of a hospital stay can be reduced by 20 per cent to 60 per cent (Audit Commission UK, 2004: 19).

Small-scale studies indicate similar outcomes. A quasi experimental study carried out by Vincent et al., in Canada, found that after providing telecare services to 38 older people, the total costs of health and social public services used per client dropped 17 per cent after the first 3 months and 39 per cent in the second 3 months. Hospital stays dropped from 13 to 4 days and home care services decreased from 18 to 10 visits for each client over 3 months. The participants expressed a high level of satisfaction with the service (Vincent et al., 2006).

Telehealth

Telehealth can significantly reduce hospitalisation. In one study, telehealth devices, including the remote monitoring of vital signs improved compliance with medication regimes from 34 per cent to 94 per cent and reduced hospital admission rates for patients with congestive heart failure by 41 per cent (Audit Commission UK, 2004; 20), (Lehmann, 2005). 4

Assistive devices and environmental adaptations

Simpler low-cost aids, equipment and home modifications can also reduce hospitalisation and health care costs. A randomised controlled trial conducted by Mann et al involving 104 older people found that the costs for the control group who had received usual care were higher than for those provided with assistive devices and home modifications. The devices included bath benches and walkers. Home modifications were as simple as re-arranging furniture and removing items that created unnecessary risks (Mann et al., 1999). A number of other studies identify economic and preventative health and safety benefits from using simple assistive devices and environmental adaptations at an early stage (Heywood & Turner, 2007), (Lansley et al., 2004). Simple case studies illustrating the safety and prevention impacts of telecare are provided in a report published by the Department of Health UK in 2005 titled Building Telecare in England. These case studies are extracted on the following page.

4. The health outcomes of assistive technology were largely outside the scope of this project, (as described in Section 2: Method) which is why telehealth is only briefly examined.
Case Study 2

Mrs B has a history of falling. Following discharge from hospital she was provided with a basic telecare package that included a bed pressure sensor that could detect when she left the bed during the night and turned on the lighting to her bathroom. It would then trigger an alarm if she did not return to bed within an agreed time.

The package was programmed to record how many times Mrs B left her bed during the night. A few weeks after it was installed it was noticed at the control centre that Mrs B’s nocturnal visits to the bathroom had increased significantly over a three day period. They alerted a care professional and Mrs B was diagnosed with a urinary tract infection which was then quickly treated enabling a full and quick recovery.

(Department of Health UK, 2005: 9).

Case Study 3

Mrs A has dementia and was starting to forget to turn off the gas when cooking. She had a gas detector installed, with an automatic shut off valve when gas was detected in the air. This enabled Mrs A to continue living in her own home, and still cook for herself. In time, a movement detector was added.

It can differentiate between her opening the door to retrieve the milk delivery and when she opens the door and leaves the flat. Carers are not, therefore, alerted every time the door opens, but can intervene if appropriate and help if she leaves the house on her own.

(Department of Health UK, 2005: 9)
5.3 Ease of living, mobility and independence

Assistive technology can make things easier for older people and their carers, enabling them to be more independent. The literature supports this conclusion where assistive technologies are used effectively. There is recognition in the literature of the difference between efficacy (what works under ideal conditions) and effectiveness (what works in reality). The effectiveness of assistive technology chiefly depends on whether it is used as intended (Audit Commission UK, 2004: 17).

Older people particularly value the independence given to them by showers, stair-lifts and downstairs toilets (Heywood, 2001). In circumstances where older people are provided with training and follow-up home visits to ensure they are using the devices properly, they report a high level of satisfaction in terms of improved functioning and independence. In particular, these benefits have been established for older people recovering from a stroke. A randomised controlled trial carried out by Chiu & Man found that the intervention group (who were provided with bathing devices and follow up training) improved significantly in functioning and independence (as measured by the Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST) instrument and the Functional Independence Measure (FIM), which includes both FIM motor and FIM cognitive measurements). In this study, 53 adults were randomly assigned to either an intervention group or a control group. Both groups were prescribed with bathing devices and provided with training in the use of the devices. The intervention group received additional home-based training immediately after discharge. When assessed after three months, the rate of use was significantly higher in the intervention group (96.7 per cent) when compared to the control group (56.5 per cent) (Chiu & Man, 2004). This study received the second highest rating (II) in the Table of evidence at Appendix D, as it is a properly designed randomised controlled trial. The study is noted again in Section 6.2 of this report as it supports the finding that human support (in the form of home-based training) is critical to the uptake of assistive technologies.

5.3.1 Increased active and healthy lifestyles

Assistive technology can compensate for disabilities and reduce participation restrictions, helping to promote independence and quality of life (Edwards & Jones, 1998). The use of assistive devices by older adults has also been associated with less use of personal care and better function (Mann et al, 1999). This may enable older people to lead active and healthy lives for longer.

A randomised controlled trial by Mann et al. conducted in the United States showed that the provision of assistive technologies can slow the loss of function if the uptake and application of assistive technologies is systematic. The ‘systematic’ application of assistive technologies, in this case, refers to the provision of aids and appliances and carrying out environmental interventions in the home. All participants in the study underwent a comprehensive functional assessment and evaluation of their home environment. Those participants in the intervention group received aids and appliances based on their needs, including canes, walkers and bath benches. They were also provided with environmental interventions to their homes, including lowering cabinets, removing floor rugs and providing ramps. The control group were provided with ‘usual care services’. Changes in the intervention and control groups were measured according to the Functional Independence Measure (FIM), the Craig Handicap Assessment and Reporting Technique and the Functional Status Instrument. After 18 months all participants showed a decline in FIM total score and FIM motor score. However, the decline in function experienced by the control group was significantly more than in the intervention group (who were provided with assistive technologies). The difference in percentage decline on each of the measures ranged from 2.7 to 13.3 percentage points. The control group (who were not provided with assistive technologies) required more expenditure for institutional care, while the intervention group (who were provided with assistive technologies) required more expenditure for the technologies. The control group also required ‘significantly greater expenditure’ for nurse visits and case manager visits (Mann et al., 1999). This study was given the second highest rating (II) in the Table of evidence at Appendix D as it provides evidence obtained from a properly designed randomised controlled trial.

5. The exact figures for expenditure in US dollars are set out in the study by Mann et al., 1999: 216.
5.3.2 Improved independence and reduced dependence on carers

Assistive technologies can reduce the dependence of older people on carers and the strain on informal caregivers, social services, and health care professionals (Edwards & Jones, 1998). Even where carers report no reduction in actual contact time as a result of assistive technology, they consistently describe feeling more confident about leaving older people alone. Telecare, in particular, increases the confidence of carers and families (Vincent et al., 2006). A quasi-experimental study on the use of telecare services conducted by Vincent et al in Canada made a number of findings, including that caregivers’ psychological burden ‘decreased substantially’ when telecare services were provided. The objective of the study was to document outcomes and cost evolution of a nurse-staffed telesurveillance system for frail elderly people living at home. The study involved 38 patients and 38 caregivers. In total, 957 calls over a 6-month period were recorded. Only 48 (5.0 per cent) of the calls were health-related. Over a 3 month period, the length of hospital stays dropped from 13 to 4 days, and home care services decreased from 18 to 10 visits per client. The total cost of health and social public services used per client dropped by 17 per cent after the first 3 months and by 39 per cent in the second 3 months. This study was noted in Section 5.2.3 of this report in relation to prevention of hospitalisation. It is also relevant to the Costs Section at 6.5. In the Table of evidence at Appendix D, this study was given the third highest rating (III-1), as it provides evidence from a well-designed pseudo randomised controlled trial.

Smart technology has also been shown to reduce the anxiety of carers. In the evaluation of the smart flat (described in Case Study 1 at Section 4.4.1), Evans et al described how the daughter of the older tenant who was suffering from dementia was ‘very supportive and much relieved that the installation seemed to be providing real support for her father’ (Evans et al., 2007). This evaluation by Evans et al was included in the Table of evidence at Appendix D.

5.4 Social connectivity and preserving cognitive abilities

5.4.1 Supporting social connection

This section examines the evidence relating to assistive technology use and social connection. Depression in older people is often associated in the literature with social isolation and functional decline. Depressed adults report lower feelings of independence, increased chronic medical problems, poor health, disability and general physical weakness (Mann et al., 2008). Heywood & Turner note that in the United Kingdom, there is a 30 per cent increased risk of hip fracture for older women if they are suffering from depression. This statistic was noted in passing in the context of a much broader discussion by Heywood & Turner of the outcomes of assistive technologies (Heywood & Turner, 2007: 4).

The impact of depression on the physical and mental health of older people is mentioned here because there is a risk that assistive technology may increase the social isolation experienced by older people. Interestingly, however, the authors found remarkably little material to support the hypothesis that assistive technology increases social isolation. This may be because there is very little material available on this issue or simply because the authors did not encounter this material in the research process. Instead, evidence was found to support the idea that older people appreciate the flexibility and independence enabled by assistive technology (as explored in the previous sections) and that technology can also increase the social connection experienced in the everyday lives of older people. This evidence is described below. Overall, however, it appears that more research is needed in this area to properly establish the links between assistive technology use and the potential for social isolation and/or social connection, as noted in Section 7.2: Gaps in research.

A study by Marchant et al. in the United States noted that older adults are one of the fastest growing groups of computer users, and have been shown to uniquely benefit from computer access. In the United States, adults over the age of 50 years were the fastest growing group of internet users between 1998 and August 2000 (Marchant et al., 2005). In the study by Marchant et al., 32 older adults (aged 61 to 87) with disabilities who owned a personal computer were interviewed in their homes and observed during performance of a familiar computer task. The aims of the study were to explore computer use of older adults, focusing on...
the relationship between workstation, performance, satisfaction and reported pain. It found that older adults with disabilities are using computers for many tasks, view their computers as important and are generally satisfied with their ability to use their computer (Marchant et al, 2005). Another study by McConatha et al, found that older adults who have been trained to use computers have experienced increased ability in activities of daily living, increased cognitive levels and decreased levels of depression after six months (McConatha, McConatha & Dermigny, 1994). A study by Purnell & Sullivan-Schroyer (1997) involving residents at a nursing facility who were trained in the use of computers reported that they felt higher levels of self-esteem and a sense of productivity (Purnell & Sullivan-Schroyer, 1997). Older people with disabilities have also reported feeling less isolated, better informed about health issues, and more socially connected as a result of using computers (Malcolm et al., 2001).

5.4.2 Increased social confidence

Research indicates that some older people feel increased confidence when they know help will arrive quickly in an emergency. A pilot study in Ireland showed that the installation of basic telecare services, such as an alarm pendant, reduced fears of falling and decreased the social isolation felt by older people. Following the installation of telecare, the number of people fearing a fall event was reduced by 50 per cent. Two participants had not previously ventured outside due to poor mobility and fear of crime. Telecare packages were seen to enable these participants to go outside and transformed their quality of life (Joint Improvement Team, 2008: 13).

Promoting mental and physical health through technology

The TRIL Centre in Ireland (Technology Research for Independent Living) favours a particularly social model for understanding the role of technology in supporting independent living. The Centre’s research is underpinned by ethnographic studies on the physical, cognitive and social consequences of ageing (TRIL Centre, 2008). By observing people in their ‘natural habitat’ the centre draws on ethnography to inform the development of technology about what older people find easy or difficult, and what devices would assist them day to day.

The Centre identifies impaired cognitive function and its consequences to have the biggest limiting impact on older people’s independence. They identify links between social isolation and cognitive decline. The consequences of impaired function include: accident proneness - falls, burns, bruising and cuts; self-neglect - missed medication, not eating properly; poor hygiene, failure to notice or report medical signs and symptoms, loss of initiative, diminished repertoire of activities and low mood. Members of the TRIL Centre are comparing the effects of technological interventions to traditional interventions that improve social engagement. They measure differences according to a range of mental and physical health outcomes.

http://www.trilcentre.org/
5.5 Well-being and quality of life

Well-being describes a person’s happiness, confidence, health and overall frame of mind. A person’s care arrangements have a major effect on their well-being. This section explores the potential for assistive technology to support older people’s well-being and quality of life.

5.5.1 Increased capacity to continue living at home: ageing in place

Recently assistive technology research has focused on how to provide integrated care to frail older people with high level care needs who desire to continue living at home. This section explores this research, particularly studies emerging from the United Kingdom. For some frail older people, assistive devices, home modifications and the provision of basic telecare services, such as an alarm pendant, may be enough to defer the need for residential care. For other frail older people, however, these interventions may not be sufficient to address their care needs.

Older people with dementia

Research carried out by Dunk & Doughty has shown that with an appropriate level of assistance from family and carers, assistive technology, particularly telecare can help people with very low cognitive abilities to remain in their own homes. In a study involving people with dementia and assistive technology, researchers found that functional ability, rather than cognitive ability, was a greater indicator of the person’s potential to be supported by technology (Dunk & Doughty, 2006).

Smart home technology and telecare services are considered particularly appropriate for people with dementia. An evaluation of the ‘enabling smart flat’ set up in London (explored in Case Study 1 at Section 4.4.1) found that the tenant’s quality of life and continence improved while living in the smart flat (Evans et al., 2007).

Evaluation of the West Lothian Project - Scotland

(Bowes & McColgan, 2006)

Some of the most innovative ways of using assistive technology have been developed in West Lothian in Scotland. In response to challenges in the late 1990s, West Lothian Council partnered with industry bodies to develop the ‘Opening Doors for Older People’ initiative (Bowes & McColgan, 2006: 20). The objective of this initiative was to:

‘Provide an innovative form of housing for older people with support needs that will sustain independent living through effective physical design, focused on individual care planning and the efficient use of new technologies’.

The project trialled a radical shift in investment from residential care to providing services to people’s own homes. Four of six residential homes were closed down and were replaced by built housing with smart technology. The larger part of the project (designed for all people over the age of 60), involved modifying people’s existing homes by installing tailored smart technology to suit their needs.

Phase one of the project involved Tunstall Telecom Ltd entering into a partnership with West Lothian Council in 1999 to take forward the development of smart technology in the home. Packages of technology were installed in 75 homes.

Phase two involved a tendering exercise in May 2002 which confirmed Tunstall Telecom Ltd as the providers of smart technology and enabled the Council to upgrade its Community Care Alarm Service to the ‘Home Safety Service’ by February 2003.

Phase three involved rolling out the Home Safety Service to all people over the age of 60 living in West Lothian. The services were extended in December 2003 and its success was highly dependent on effective marketing strategies.

By May 2006, the Council had approximately 2150 people using the ‘Home Safety Service’ (Bowes & McColgan, 2006: 22). The smart technology usually involved a minimum of:

• a home alert console, which links sensors to the call centre when they are triggered
• two passive infra-red detectors to monitor activity and potential intruders
• two flood detectors, activated by leaking pipes, overflowing baths
Comprehensive scoping study on the use of assistive technology by frail older people living in the community

- one extreme heat sensor, sensitive to both high and low temperatures
- one smoke detector.

The devices were wireless and plugged into a traditional phone socket (Bowes & McColgan, 2006: 24). Where appropriate, the technology package was supplemented by a number of hours of formal support and care.

People with specific care and support needs were provided with the package after they were properly assessed in terms of their individual needs. Often the basic package was also supplemented with additional technological devices, including further passive alarms, a device alert for when the front door is open as well as fall detectors (Bowes & McColgan, 2006: 25).

An independent evaluation of the West Lothian project by Bowes & McColgan found that many older people living at home appreciated the positive impacts of the smart technology. Older people felt that it increased their quality of life, in terms of ease of living, safety and security, and peace of mind (Bowes & McColgan, 2006: 8). The comments collected from the study are extremely supportive of the initiative and indicate that even where older people were initially reluctant about the technology, they embraced the service once they saw it work. Some respondents revealed that the technology had saved their life a number of times since it had been installed. For others it calmed their fears that they would die alone in their homes and not be discovered (Bowes & McColgan, 2006: 69-72). The mainstreaming of this technology (providing it to everyone in the area over 60) had positive impacts on how older people viewed the changes, as the stigma of receiving assistance was minimised.

This study was assessed as sufficiently rigorous to be included in the Table of evidence at Appendix D. It was given a rating of (IV), indicating that it provides evidence from a post-test case study.

Smart Housing in Australia – examples from Queensland and New South Wales

Although there are no large-scale smart housing initiatives in Australia, the technology is available. There are two key examples of so called smart houses in Australia. These are: the Queensland Smart Home Initiative (QSHI) and the Baptist Community Services ‘Age Friendly Home’ in New South Wales. These smart houses are used as demonstration sites where health care professionals, older people and their families can use and test a range of assistive technology. These two sites also provide a model for how assistive technology can be mainstreamed.

The QSHI showcases local and international innovations to support independent living and home care. The project contributes to the national centre for ICT in Ageing, Aged and Community Care, which is to be located in Queensland. The QSHI also conduct research regarding the gaps and opportunities in the area of health care for the disabled, chronically ill and aged. 6

In New South Wales, Baptist Community Services have set up an Age-Friendly Home that integrates a range of assistive technologies to support older people in the community. The home has been modified to suit older frail people with limited mobility. Bathrooms, kitchens and laundries have been adapted, safety switches have been installed and a sophisticated remote care management system has been set up in the house. This includes health monitoring systems, medication reminders and video conferencing. The house is designed to showcase how readily-available and easy-to-install technology can assist elderly, disabled or vulnerable people to continue to live independently and to live well. 7

While there is currently a paucity of research in this area in Australia, smart housing may be able to help realise government and industry ageing in place policies and initiatives. It is possible that future housing industry standardisation and building regulations that incorporate assistive technology could drive down cost, and provide opportunities to offer assistive technology that is compatible with existing home appliances, devices, and community support services.

6. The Queensland Smart Home Initiative can be viewed at http://www.usq.edu.au/community/partnerships/smarthome.htm

7. Information about the Baptist Community Services Age Friendly Home can be viewed at http://www.bcs.org.au/pages/content.asp?plid=313
The case study below by Dunk & Doughty illustrates the impact of comprehensive telecare packages on the capacity of a 90 year old woman to continue living at home. The broader publication which contains this case study by Dunk & Doughty was included in the Table of evidence at Appendix D. It was given a rating of (IV) indicating that is provides evidence from pre and post-test case studies.

**Case Study 4**

(Dunk & Doughty, 2006: 10)

A 90-year old lady with moderate/severe dementia lived alone. She was admitted to the mental health acute admission ward after being found by the police in the street in the early hours of the morning, having wandered from home. Her next-of-kin was a nephew who lived 2 hours away. She had 2 local friends, one of whom lived in the same road. Whilst on the ward, Mrs O was extremely disorientated, requiring constant reassurance from staff. She frequently tried to leave, to the extent that she was sectioned under the Mental Health Act (UK). She consistently told staff that she wanted to go home but was considered to be too vulnerable to return there. Plans were made to find a suitable residential placement.

Mrs O was referred to a telecare technology team to see if there was any possibility of returning home. An Occupational Therapy assessment was undertaken, which concluded, that although Mrs O was disorientated, with extremely poor memory, she was able to undertake certain routine and familiar tasks e.g. making a cup of tea or coffee, demonstrating few concerns with sequencing or organisation, but extremely vulnerable to distraction. The situation was reviewed with her family and risks identified including nocturnal wandering, falls, risk of exploitation from others, gas escapes from gas appliances, risk of fire through cooking, and hypothermia through mismanagement of heating.

A detailed technology care package was prepared which included a smoke alarm, carbon monoxide alarm, gas alarms for both cooker and fire, a heat extremes sensor in the kitchen, a thermostat which provided an alert if the house temperature fell too low, bed occupancy system set from 11 pm, and two wandering client systems; one set for daytime enabling Mrs O to go to the local shops, which was important to her, but would raise an alert if she did not return after a set period. A second system was set for night, with an immediate alert, as she would be at great risk going out at night, when her level of agitation and disorientation were high. Detailed response protocols were prepared for the Call Centre and Croydon Careline which also had details of all her local ‘haunts’, to enable them to locate her in the event of wandering. Mrs O had a substantial care package of 4 visits per day, and training was given to all the carers to ensure they understood the equipment, particularly the wandering client system.

Mrs O finally returned home in Sept 2004, and remained at home for 7 months, finally going into emergency respite before her death, therefore achieving her wish to remain at home.
5.5.2 Health at home in the community

Health is an important aspect of well-being. Although the focus of this scoping study is the community care context, as many people age, the most essential factor determining their care arrangements is the nature and extent of any underlying health problem. There are a large number of studies predicting the use of formal or informal care according to health status (Agree et al., 2004: 274), (Bowes & McColgan, 2006: 68).

There is now a strong international move towards the use of telehealth (the remote monitoring of vital signs) in the provision of health care (Audit Commission UK, 2004: 22). Although a number of the stakeholders interviewed for this study supported the use of telehealth services, others were cautious about the utility of such comprehensive monitoring systems, likening them to surveillance. Telehealth has been shown to be effective where it is supported by carers and other health professionals, as explored in Section 6.2.

A National United States survey conducted by Philips indicated that industry use of telehealth is expected to double over the next two years, principally as a means of managing patients with chronic disease. Over 88 per cent of agencies reported that telehealth services led to an increase in quality outcomes, as evidenced by a reduction in unplanned hospitalisations and emergency visits, and over 71 per cent reported an improvement in patient satisfaction.

Among the findings were:

- 17.1 per cent of agencies use some type of telehealth system. A much higher percentage of large agencies (32.0 per cent) reported that they provide telehealth services
- 88.6 per cent of those surveyed reported that telehealth programs improved the overall quality of services provided to patients
- 76.6 per cent reported a reduction in unplanned hospitalisations
- 77.2 per cent reported a reduction in emergency room visits
- 83.9 per cent state that less than one in ten patients refused a home telehealth system
- 79.2 per cent of patients or family members were reluctant to have the telemonitoring system removed
- 42.8 per cent reported that telehealth led to a reduction in cost. A similar number reported it as cost-neutral.

5.5.3 Rural and remote communities

Telecare and telehealth services are particularly effective in rural and remote communities. A review of anecdotal evidence and pilot studies identified benefits including reduced length of hospital stays, reduced attendance at emergency departments, improved patient access to professional advice and counselling without having to travel long distances, wider professional contacts and reduced feelings of isolation for local health workers and patients. This is considered to improve opportunities to attract staff to work in isolated areas (Wakerman et al., 2006: 28-29). This research suggests that remote monitoring technology has significant potential to improve the quality of care provided to rural and remote areas of Australia.

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8. This is an industry funded study by Philips, co-sponsored the National the role of technology delivery by Medicare-certified agencies to more than 4.2 million older people each year. The study took nearly a year to complete and involved a total of nine hundred and seventy-six (976) agencies across the United States. It is the largest study conducted to date on the use of telehealth in home care in the United States.
6 barriers and enablers to assistive technology
6 Barriers and enablers to assistive technology

This section is a review of the barriers and enablers to assistive technology use, including the factors that correlate with use and non-use of assistive technologies. Firstly, this section briefly discusses the statistics available on the rate of abandonment of assistive technologies before examining the broader literature relating to barriers and enablers. In summary, the literature suggests that strategies to increase and sustain the uptake of assistive technology will require:

- human support (including training and follow-up maintenance)
- improving and mainstreaming the design and visual appearance of assistive technologies
- addressing affordability of assistive technology
- clear points of access, information and assessment
- increased education about what is available
- the correct prescription of assistive technology
- more research involving older people.

Almost all stakeholders interviewed for this scoping study emphasised that very little research has been carried out on the attitudes of older people in this area. Building on this research will be essential if assistive technology is to be widely adopted by older people.

6.1 Abandonment of assistive technologies

For assistive technology to successfully support older people, they must be willing to use assistive technologies and sustain its use over a period of time. The research shows that even where people are provided with assistive technology devices, there is a very high rate of abandonment (Roelands et al., 2002: 43), (Gitlin et al., 1998: 170), (Waldron & Layton, 2008: 63). Some studies estimate that between 30 to 59 per cent of assistive technology devices are not used (Scherer, 2002). Philips et al. identify four significant features relevant to the abandonment of assistive technologies: (1) lack of consideration for the user’s opinion (2) inability to procure the device easily (3) poor device performance, and (4) change in user needs and priorities (Philips & Zhao, 1993), (Chiu & Man, 2004). Abandonment of devices is highest in the first year and after five years. For abandonment in the first year, it is highest in the first three months (Chiu & Man, 2004). Although the reasons for abandonment will vary from person to person, the high rate of abandonment of assistive devices identified in the literature make the following sections particularly relevant to sustaining the use of assistive technologies generally.

6.2 Human support

A recurring theme in the literature is that assistive technology is not effective without appropriate human support (Chiu & Man, 2004), (Finlayson & Havixbeck, 1992), (Evans et al., 2007), (Dunk & Doughty, 2006). The literature demonstrates the crucial role of ongoing support from carers and families in ensuring older adults use assistive technologies. The overwhelming view of professionals is that while the technology available is often of a very high quality, it is only successful when the people involved support it appropriately. The key ways human support can improve assistive technology use is through:

- training and maintenance
- tailoring technological solutions to individuals
- responding to information gathered through monitoring, including crisis calls
- providing ongoing support.

Research indicates that once prescribed, the non-use of assistive technology devices can be largely prevented through training, follow-up home visits and appropriate levels of human support. A randomised controlled trial conducted in Hong Kong by Chiu & Man mentioned at Section 5.3, showed that where additional home-based training was provided immediately after discharge from hospital the uptake of assistive technologies was dramatically increased from 56.5 per cent to 96.7 per cent (Chiu & Man, 2004). Similar research in Canada has also identified the significant impact of home training in sustaining the use of assistive technologies (Finlayson & Havixbeck, 1992).

The importance of home-based support was emphasised by the stakeholders interviewed for this study. One stakeholder pointed out that a common problem is that batteries regularly fail and are not replaced. Sometimes the solution is as simple as making sure basic maintenance is carried out (See the discussion on maintenance at Section: 6.6.1).

The importance of encouragement from caregivers and health professionals is significant in people’s decision to use assistive technologies. The views of General Practitioners have a particular impact. A Belgium survey of a representative sample of 491 community-dwelling
elderly people aged between 79 and 89 years found that older people placed the greatest value on the opinions of General Practitioners (63.4 per cent), followed closely by the older person’s children (52.8 per cent) and the older person’s partner (47.2 per cent). Nurses (21.3 per cent) and the older person’s friends (12.3 per cent) were mentioned less often. Only 4.1 per cent of older persons in the study said they did not value anybody’s opinion regarding the use of assistive devices (Roelands et al., 2002: 45-46).

The Best Practices Guide for the Prevention of Falls Among Seniors Living in the Community (based on a systematic review described at Section 5.2.2), also concluded that the success of home modification programs to prevent falls may be enhanced when combined with other strategies such as education and counselling (Scott et al., 2001).

The importance of the care team in supporting complex interventions for older people with high level care needs is considered key to their success (Evans et al., 2007: 36). For telecare, telehealth and smart technology, a well-organised collaborative effort between technicians, health professionals and carers is essential to ‘close the loop’. Multidisciplinary teams involving mental health workers, occupational therapists, dementia services advisors, family representatives, and engineers have been effective in supporting complex telecare and smart technology interventions (Evans et al., 2007: 33).

Remote monitoring technology is only effective when an appropriate response is organised. Although sometimes remote monitoring facilities notify family directly as a first point of contact, it is often not practical or reasonable to expect families to provide 24 hour on-call support. The availability of care professionals is significant in the sustainability of such arrangements. To make this happen there must be well-established protocols and procedures in place to provide timely and reliable responses and to respect the privacy and security of the older person. The quality of these arrangements is critical if older people are to remain at home rather than enter residential care (Evans et al., 2007). (Dunk & Doughty, 2006), (Bowes & McColgan, 2006: 125), (Beswick, 2008: 9).

New models of care – West Lothian Project - Scotland

Research into the use of smart technology in the community care sector has emphasised the role of a new ‘model of care’. The evaluation of the West Lothian project discussed at Section 5.5.1, examined the effects of using smart technology on the care staff involved. A total of 79 members of staff involved in the pilot were interviewed from a wide range of backgrounds. Many members of staff were initially challenged by changes to their roles. However, the large majority of the staff felt they benefited from new ways of thinking about care and support, and appreciated the flexibility made possible by the technology. They found they began to see themselves more as a support person rather than carer. Many staff felt that the pilot had positive impacts on the independence of older people. Care staff involved in the early stages of the project were more supportive of the project overall and communicated a sense of ‘ownership’ over the initiative (Bowes & McColgan, 2006: 30).

One way of viewing the critical relationship between carers and technology is provided by Oder who uses concepts of ‘hard technology’ and ‘soft technology’. The actual devices, adaptations and monitoring equipment constitute the ‘hard technology’, whereas ‘soft technology’ describes the related activities, such as clinical advice, needs assessment, customisation, training and follow-up sessions (Oder cited in Waldron & Layton, 2008).
6.3 Acceptability of assistive technology to older people

Evidence shows that older people are willing to use assistive technologies but there are some factors which support a greater willingness (McCreadie & Tinker, 2005: 103; Roelands et al., 2002). As examined below, supporting the initial uptake of assistive technologies requires a complex understanding of older people’s attitudes and sense of personal identity.

There is a common perception that older people are reluctant to learn new things and are technophobic. This view is not entirely supported by the literature. The large-scale United States study conducted by Barrett on older people’s attitudes revealed that many older people are interested in using assistive technology, particularly when it could help them maintain social contact, be safe at home, and promote their personal health and wellness (Barrett, 2008: 1). The willingness of older people to use assistive technologies often outweighed their knowledge of the technology (Barrett, 2008: 8). The literature suggests that older people are not necessarily ‘technophobic’. Analysis of interview data from 67 people over the age of 70 years suggests that older people simply make ‘pragmatic decisions’. Where devices were straightforward, reliable and met a need, the respondents were positive about using them (McCreadie & Tinker, 2005: 104). Other studies have found that older people particularly value the control they could maintain over their lives through the use of certain assistive devices (McCreadie & Tinker, 2005: 103; Roelands et al., 2002: 45-46).

6.3.1 Effectiveness

Assistive technology will only be used by older people if they are comfortable with the technology, perceive it to be effective and decide to embrace it. One of the key factors determining this response is whether the technology is effective. It must be easy to use, and work properly, reliably and safely. ‘Product quality’ is particularly important and can vary greatly (McCreadie & Tinker, 2005).

6.3.2 Self-image

The uptake of many assistive technologies depends on whether they support or undermine a person’s sense of identity and self-image (McCreadie & Tinker, 2005: 93). Many devices remind individuals of abilities they once had that have diminished. The public, social and personal consequences of device use, such as lowered prestige, stigma and being viewed as a dependent person, become a ‘central feature of a person’s thoughts about accepting or rejecting a device’ (Gitlin et al., 1998).

Stroke patients are often particularly susceptible to cultural attributions of stigma associated with assistive technology use during their rehabilitation. A stroke brings about a sudden and complete change in a person’s cognitive functioning and physical ability and challenges their personal identity and self-image (Gitlin et al., 1998). In a study on perceptions of stroke patients and their use of assistive technology devices, mobility devices received the most negative and mixed type comments, possibly because they were most socially visible aids (Gitlin et al., 1998: 174).

6.3.3 Mainstreaming and design

The visual appearance of aids, equipment and home modifications is particularly important to older people. The particular style and design of assistive technologies can impact on the confidence of users and how they feel about their changing physical condition. Criticisms have been made that too often devices and appliances have a ‘one size fits all’ approach (Audit Commission UK, 2002: 31). Being able to purchase an aid or appliance that is stylish in appearance provides a degree of control for some people. Anecdotal information from stakeholders interviewed for this study consistently revealed that many older people dislike home modifications that make their environment look like a hospital. The unattractive appearance of hand rails, in particular, is an immediate barrier to people’s willingness to install them, despite their well-known safety benefits.

Mainstreaming assistive technology is emphasised in the literature as an effective strategy to overcome feelings of stigma and shame (Bowes & McColgan, 2006: 8), (Agree et al., 2004: 268). Mainstreaming involves normalising the use of technology so that it is not associated with dependence or disability, for example by providing the technology to everyone over the age of 65 regardless of their level of need. Mainstreaming smart technology was an important part of the success of the West Lothian project mentioned earlier at Section 5.5.1. Providing packages to 60 households in the local authority area meant that smart technology became something that was simply part of the built environment and ‘taken for granted’.

Mainstreaming smart technology also meant that people did not have to admit they were not able to cope alone.
The mainstreaming strategy was particularly effective in reducing feelings of stigma for older people experiencing the onset of dementia (Bowes & McColgan, 2006: 130). Japan has taken a different approach to mainstreaming in an attempt to support people experiencing dementia in its society. In 2005, the Japanese Ministry of Health, Labour and Welfare launched a 10-year nationwide public Campaign to Understand Dementia and Build Community Networks. The campaign is motivated by research that shows that the peripheral symptoms of dementia experienced by older people are considerably affected by the attitudes of the community around them. Increasing community awareness and promoting the idea that dementia is a normal part of ageing is a mainstreaming strategy to change views in the general community.

9. This research is reported by the International Longevity Center in Japan available at http://longevity.ilcjapan.org/j_issues/0603.html

6.3.4 Personal characteristics and attitudes

The literature suggests that personal characteristics and attitudes may have a bearing on the uptake of assistive technology. This information could be relevant when designing educational programs promoting its use. Overall, empirical evidence on the role of psychological variables in the use of assistive technology is limited (Becker et al., 2005). There is a major gap in this type of research in the Australian context which may help to tailor interventions to particular social and cultural groups. However, there is some international literature available on the topic. Some authors emphasise the importance of personal and psychosocial factors in matching consumers to assistive technologies, regardless of age, gender and physical locality (Scherer et al., 2005). A social-cognitive model emphasising the role of attitudes, subjective norms, behaviour intention and self-efficacy in understanding the use and abandonment of assistive devices is advocated by Roelands et al., 2002). A number of researchers note the importance of the stage in the person’s life, person’s beliefs and values, and the nature of the disabling condition (Gitlin et al., 1998: 169), (Cornman et al., 2005).

Socio-cultural factors may impact on the uptake of assistive technology. Some researchers identify correlations between the personal characteristics of older people and the use and non-use of devices. Some studies have examined the use of aids, such as bathing devices and mobility support, according to gender, ethnicity, marital and educational status. In the United States, a study on older people and mobility-related technology devices found that ‘minority status’, particularly people with an Hispanic background was consistently associated with less use of formal care and earlier use of informal care. In contrast the use of assistive technology appears higher among African Americans (Agree et al., 2004: 278). One study found that people who live alone are significantly more likely to use assistive devices to substitute for human assistance (Resnik & Allen, 2006: 111).

The chronologcal age of people may be less important to the uptake of assistive technology than is their perception of their own needs. McCreadie & Tinker argue that the acceptability of assistive technology to older people depends on ‘felt need’ for assistance. Felt need is different to actual need. Four factors were considered particularly important:

- the older person’s disability
- their living arrangements
- care needs
- personal motivations and preferences (McCreadie & Tinker, 2005: 101).

6.3.5 Timeliness and early intervention

For assistive technology to be accepted by older people and for it to make a difference to a person’s functional abilities, it must be introduced early in the recovery process. The authors did not find substantial material relating to early intervention, however, the stakeholders interviewed for this study strongly emphasised the need to introduce older people to assistive devices early in their process of recovery after an accident or stroke. Some stakeholders interviewed described how people develop habits of dependency quickly during the recovery process and that it becomes increasingly difficult to re-learn skills once a person has adjusted to new physical limitations.

A 1998 study by Gitlin et al found that very little is known about older people’s perceptions about device use, particularly in the early stages of recovery. The study used a structured and qualitative approach to explore the perceptions of 103 stroke patients to assistive devices. Over 100 different types of assistive devices were issued during rehabilitation. Gitlin et al concluded that the introduction and instruction in the use of assistive devices is a key rehabilitative strategy for older people who have had a stroke. They also concluded that more empirical data is required to understand the experiences of older people in the early stages of recovery (Gitlin et al., 1998).
6.4 Access, information and assessment

A major barrier to the use of assistive technologies is the absence of clear points of access and information. The correct prescription of assistive technologies is important if the device is to be effective. This cannot be done without clear referral processes and places for assessment (Roelands et al., 2002: 43), (Waldron & Layton, 2008: 63), (McCreadie & Tinker, 2005: 104), (Barrett, 2008). Older people may be inclined to dismiss assistive technologies where they have had negative experiences or have used the technology without proper training or assessment.

Almost all stakeholders who were interviewed felt that older people in Australia are not aware of what is available to support them to continue living at home. In the large United States study conducted by Barrett, older people and caregivers were remarkably unaware of what was available, despite demonstrating an interest in using technology. The study found that both carers and older people would benefit from knowing more about the range of technological innovations currently available (Barrett, 2008: 3). Lack of access to information has also been considered a significant barrier to the use of assistive technologies in England and Scotland (McCreadie & Tinker, 2005: 104).

The authors found very little literature in the Australian context examining access and information points in the different Australian states and territories. One study published by Jones et al for the Australian Housing and Urban Research Institute (AHURI Positioning Paper No. 103) examines access to home maintenance and modification services across Australian states and territories in some detail (Jones et al., 2008: 40-52). The study is focused more on the funding arrangements that exist in Australia and presents an analytical framework for research and policy development relating to home maintenance and modification services. The details of this study are presented in Section 6.6 of this report in relation to implementation issues.

In terms of other types of assistive technologies, the literature available about access and information is minimal. This lack of information is identified as a gap in research in Section 7.2: Gaps in research, in the conclusion of this study. Two examples of Australian organisations working to increase access to assistive technology and to improve assessment and prescription procedures for older people are provided below. Stakeholders indicated that ‘word of mouth’ was a common way for people to find out about these services.

Independent Living Centres

In Australia, the Independent Living Centres provide one way of accessing relevant information about assistive technology, particularly for aids, appliances and equipment. There is an Independent Living Centre in every state and territory, excluding the Northern Territory. The Centres record information in a national database about assistive technology items available in Australia. They also record useful information about client needs. The importance of careful assessment is promoted by the Centres as they aim to overcome barriers such as: limited access to assessment and clinical reasoning, limited funding options and the potential confusion caused by different types of assistive technologies. The Centre identifies a lack of awareness of both high and low technology solutions as a barrier to uptake and emphasises the appropriateness of combining these to meet individual needs. An example of how the Centres promote awareness was provided by a stakeholder interviewed for this study. The stakeholder described how the Western Australian Independent Living Centre has purchased a specially equipped bus, which is used to tour throughout Western Australia providing information about assistive technologies to rural and remote towns and communities, particularly Indigenous communities.

Independent Living Centres Australia can be viewed at http://www.ilcaustralia.org/home/default.asp

Lifetec - Queensland

Lifetec Queensland is a not-for-profit organisation that delivers information, consultation and education about the correct application of assistive technologies. It aims to address the problem that many people purchase “off the shelf” solutions without seeking clinical advice. As a state-wide service Lifetec Queensland’s staff regularly travel to all parts of Queensland, including rural and remote areas to assist Indigenous communities. Lifetec provide services to 16,000 people each year (Barry, 2007).


Overall, the literature exploring the issues facing older people accessing assistive technologies in the different Australian states and territories is very minimal (with the exception of home maintenance and modification services and funding arrangements, described briefly above and in more detail in Section 6.6.1).
6.5 Costs

6.5.1 Costs to the individual

Cost is a considerable barrier to assistive technology use. Most assistive technologies require an initial cost outlay. As few older people are confident about the benefits of assistive technology, this initial cost is often enough to deter them from investing. United States studies indicate that both carers and older people are concerned about the costs associated with installing and maintaining new technologies (Barrett, 2008: 17). Almost all stakeholders indicated that costs are a major barrier for older people in Australia who are considering purchasing their own equipment.

6.5.2 Strategies to reduce costs

Almost no literature was identified that explored strategies to reduce costs for individuals. This lack of information about strategies to reduce costs is identified in Section 7.2: Gaps in research. While the literature does not speak directly to strategies, the stakeholders interviewed for this study put forward a range of ideas. Some stakeholders suggested that the first step in addressing these concerns would be to subsidise assistive technology equipment through Medicare. Others saw opportunities through existing community care packages, for example the Community Aged Care Packages (CACP) and Extended Aged Care at Home Packages (EACH). A number of stakeholders suggested that comprehensive assessments for assistive technology needs could be easily integrated into the EACH and CACP packages.

6.5.3 Government investment – quantifying outcomes and evaluation strategies

Cost outlay is also a barrier to investment in assistive technology at an institutional level. Evidence about the cost-effectiveness of assistive technology is still in the early stages (Bowes & McColgan, 2006: 132). However, the potential cost savings of assistive technology indicated by this preliminary research are considerable (Gosman-Hedström et al., 2002). They are explored in this report at Section 5.2.2 as measured by reduced hospitalisation for older people. Some examples from that section are provided below to reiterate the estimates noted earlier.

Since 2006, telecare services in Scotland funded through the Telecare Development Programme have resulted in:

- Approximately 1,300 additional people able to maintain themselves at home with support
- 66 delayed hospital discharges and 140 emergency hospital admissions avoided, with 1,800 hospital bed days saved
- 74 care home admissions avoided, and 6,900 care home bed days saved
- 1, 250 nights of sleepover care and 107, 000 home check visits saved (Joint Improvement Team, 2008: 2).
- The York Health Economics Consortium has provisionally estimated approximately £2.9m has been saved in Scotland as a result of these services (Joint Improvement Team, 2008: 2).
- The UK Audit Commission has reported studies suggesting that telecare services can reduce the number of hospital admissions by 25 per cent and the average length of hospital stays could be reduced from 9.2 days to 5.7 days (Audit Commission UK, 2004: 20).
- In the study conducted by Philips involving 976 agencies using telehealth in home care, in the United States 42.8 per cent said that telehealth led to a reduction of cost. Another 48.2 per cent reported that it had no impact. 76.6 per cent of agencies said that telehealth led to a reduction in unplanned hospitalisations (Philips Home Health Care Solutions, 2008).
- Research in the United Kingdom that has modelled the potential impact of telecare on older people shows that telecare focused on safety and security can reduce the number of people entering into residential care by 11 per cent in the fifth year after implementation and possibly 25 per cent, 20 years after implementation (Barlow, 2006: 2).

One of the major challenges identified in the literature is the difficulty of quantifying the cost savings and benefits created by assistive technology. Quantifying the economic benefits of assistive technology is complex because of the range of equipment available and the diversity of resources involved in its implementation. This may have an impact on the development of funding models for assistive technology. More research is needed to identify which interventions are most effective in terms of cost-benefit analyses (Heywood & Turner, 2007).

Researchers have debated the appropriate ways to conceptualise the cost-effectiveness of assistive technologies. Andrich et al. have reviewed the different cost-outcome instruments available. In applying the
Siva Cost Assessment Instrument to evaluate different assistive technology programs they emphasise the importance of incorporating an outcome analysis in this process (Andrich & Caracciolo, 2007). By applying this method to 31 individual assistive technology programs carried out over a number of years, they conclude that most assistive technology solutions, although initially very expensive, lead to considerable savings in social costs as a result of reduced assistance burden (Andrich & Caracciolo, 2007).

Schraner et al. have reviewed the methodological issues relevant to interdisciplinary research involving rehabilitation engineers, occupational therapists and economists, and explored the economic considerations relevant to the provision of assistive technologies. They explore the complexities of health economics in relation to assistive technologies, in terms of inputs and outputs (Schraner et al., 2008). A number of other studies use the Quebec User Evaluation of Satisfaction with Assistive Technology (Quest) and the Functional Independence Measure to quantify broader service user outcomes of their research (Chiu & Man, 2004: 118).

Evaluation strategies for assistive technology are not well developed in the literature. The development of an evaluation framework for telecare services has been explored by Williams & Doughty. They present an evaluation framework that enables services to be compared from several viewpoints. In their analysis they argue that because there has been no common framework used to evaluate telecare services in the past, meaningful comparisons between evaluations have not been possible. They suggest a model which includes:

- a holistic consideration of all aspects of providing a service
- a consideration and auditing of all processes and procedures
- a consideration of the viewpoints of all key stakeholders
- a clear cost-benefit analysis (Williams & Doughty, 2007: 43).

Also relevant to this discussion is the analysis of funding arrangements relating to home maintenance and modification services in Australia provided by Jones et al, detailed below in Section 6.6.1.

The need for further research in relation to cost measurement and evaluation frameworks is identified in Section 7.2: Gaps in research.

6.6 Implementation issues

This section examines implementation barriers identified in the literature and during stakeholder interviews. The available research suggests that a number of implementation barriers may need to be overcome if assistive technologies are to be widely deployed (Bowes & McColgan, 2006: 17), (Fisk, 2003), (Andrews et al., 2004), (Soar, 2006). Possibly the greatest barrier is the lack of research in this area about how assistive technology can be provided on a large-scale. Overall, the authors consider that there are major gaps in research in this area and have identified this in Section 7.2: Gaps in research. This conclusion is supported by other authors, in particular, McCreadie & Tinker (2005) have identified this weakness in the literature in terms of the viability of extensive installations of assistive technologies (McCreadie & Tinker, 2005: 91).

6.6.1 Policy frameworks and funding arrangements

There is very little information about assessment, prescription, training and maintenance, and how these can be delivered through a co-ordinated scheme to provide equitable services across Australia.

One study published by Jones et al for the Australian Housing and Urban Research Institute (AHURI Positioning Paper No. 103) specifically examines policy and funding frameworks in relation to home maintenance and modification services in Australian states and territories (Jones et al., 2008: 40-52). Jones et al argue that the home maintenance and modification service system context involves a complex array of programs and organisations at a national, state and territory level as well as at a regional and local level.

Jones et al found no publicly available documents that articulate broad policy frameworks for home maintenance and modification services in Australia. However, home maintenance and modification services are often a component of broader programs, such as Home and Community Care (HACC). Some interesting observations were made about the different states and territories by Jones et al. For example:

- Queensland has one of the most comprehensive home maintenance and modification service systems in Australia, with a wide range of geographic coverage. Only Queensland has a program providing home repairs, maintenance, minor modifications and security services to older people who are not eligible for HACC (Jones et al., 2008: 43).
In New South Wales, HACC is the primary program under which services operate. The proportion of the budget spent of the New South Wales HACC budget on home maintenance and modification is almost 6 per cent - more than most other states and territories (Jones et al., 2008: 41).

Victorian services are primarily funded through HACC and delivered through local government (Jones et al., 2008: 47).

Western Australia provides twice the national average of home maintenance services, delivered through local community organisations. However, there is limited funding for home modifications (Jones et al., 2008: 47).

In the ACT there is only one home maintenance and modification provider, however, the ACT is well serviced on a per capita basis (Jones et al., 2008: 40).

The Northern Territory provides the second-highest level of provision of home maintenance services in Australia, as indicated by national HACC data (Jones et al., 2008: 41).

In South Australia, expenditure through HACC is close to the national average for home maintenance and significantly below average for home modifications (Jones et al., 2008: 44).

In Tasmania, HACC expenditure is well below the national average for home modifications.

After reviewing the services available in each state and territory, Jones et al made a number of conclusions, set out below:

- That home maintenance and modification services are a small but important component of the service system for older people.
- That home maintenance and modification services are yet to acquire the characteristics of a mature service system, with clear goals, funding arrangements, service types, delivery mechanisms and outcomes.
- One of the reasons that home maintenance and modification services are not extensive in Australia is that many services are located within the broader HACC system. There is also no critical mass of specialised home maintenance and modification services other than in New South Wales and Queensland.
- The expansion of home maintenance and modification services is restricted because it is located at the intersection of the health, community care and housing systems, which creates difficulty in terms of defining a separate system identity, developing goal coherence, leadership and integration of multiple professional perspectives.
- Home maintenance and modification services are a complex mix of state, community, informal and market provision, and the boundaries between the state-supported home maintenance and modification systems are blurred and likely to become increasingly imprecise.
- A more rigorous and co-ordinated approach to providing home maintenance and modification services is needed if these services are to play an effective role in supporting older people (Jones et al., 2008: 52-53).

The paper by Jones et al. represents the first two stages in a broader project on the impact of home maintenance and modification systems on older people. It is composed of an international literature review and a review of the Australian service system context, and the Australian ageing policy context. The three reviews inform an analytical framework for research and policy development relating to home modification and maintenance services in Australia. The authors present a summary of their framework, which addresses: need and demand, the service system, ageing policies and outcomes (Jones et al., 2008: 78-83). They aim to build on this research framework in the remaining two components of the study, which will provide a more critical analysis of the service system and its links to ageing policy. It will also include a qualitative study of the experiences of consumers of home modification and maintenance services. The remaining sections of the study were not available at the time of publication of the scoping study report.11

11. The Australian Housing and Urban Research Institute website suggests that the title of this paper may change to ‘The Impact of home maintenance and modification services on ‘ageing in place’. The final report will be available soon at http://www.ahuri.edu.au/.
United Kingdom policy model

Some of the stakeholders interviewed for this study identified that the policy framework developed in the United Kingdom for the implementation of telecare services would provide a valuable model for Australia. The document published by the Department of Health UK, titled Building Telecare in England, (2005) provides a description of how the Preventative Technology Grant, announced in July 2004, was used to fund the deployment of telecare services in the United Kingdom. The purpose of the grant was to initiate a change in the design and delivery of health, social care and housing services and prevention strategies for older people (Department of Health UK, 2005: 8). Funding from the Grant was provided to all local authorities in England who were expected to work with partners in housing, health, voluntary and independent sectors. Pooled funding arrangements were available where partnerships were created. The document states clearly that ‘it is for each local authority and its partners to decide how best to use the grant to modernise local services and incorporate telecare into mainstream health, housing and social services’ (Department of Health UK, 2005: 10).

Local authorities were directed to the Telecare Implementation Guide for more information and examples about how to implement the services.\(^\text{12}\) Measures were put in place for performance assessment of the local authorities to quantify the outcomes of telecare over a two year period through a partnership between the Department of Health UK and the Commission for Social Care Inspection (Department of Health UK, 2005: 17).

While stakeholders identified that the UK policy framework was a valuable model, some were critical of the way the policy has been deployed, commenting on the lack of education and training given to local authorities to support their investment decisions. As each local authority was given a high degree of autonomy in how they implemented services, the provision of telecare was thought to be unbalanced across England as a result. More research into this area is needed to clarify the advantages and disadvantages of the policy model implemented in the United Kingdom.

\(^{12}\) The Telecare Implementation Guide UK is available at http://www.integratedcarenetwork.gov.uk/telecare/index.cfm?pid=293
6.6.2 Privacy and security concerns

Some authors have noted that certain privacy and security issues relating to older people need to be addressed if service users and their families are to feel confident about using assistive technology, particularly remote monitoring services (Bowes & McColgan, 2006: 17), (Fisk, 2003), (Andrews et al., 2004). Some researchers highlight the surveillance aspects of monitoring technologies and raise concerns about the privacy of older people and the appropriate use of captured information. Concerns about the ethics of electronic monitoring have also been raised, especially when full consent has not been acquired. There is potential for this to occur when an older person has dementia or is without the complete use of cognitive functions (Fisk, 2003: 238), (Soar, 2006).

6.6.3 Legislation

Currently there is very little research about the most appropriate way to:

- regulate privacy and security aspects of monitoring technologies.
- manage complaints from older people and their families to ensure a standard of care in the community is maintained, particularly in relation to safety and security and the proper handling of privacy information.
- clarify the roles and responsibilities of Commonwealth, State and Territory Governments.

6.6.4 Community standards of care

Complex technological interventions such as remote monitoring that need to be supported by a 24 hour support service create a number of logistical problems. Researchers and stakeholders reiterate the importance of developing community standards of practice for the use of remote monitoring services. There is also uncertainty about how technology will impact on existing community care standards and practice.

6.6.5 Education

The stakeholders interviewed emphasised the importance of training and educating carers and service providers in order to support the large-scale implementation of assistive technology services. This is particularly important in order to overcome organisational barriers and reluctance to use assistive technology. The importance of these issues was recognised in the evaluation of the West Lothian Project described at Section 5.5.1. Clinicians who are uncomfortable with or resistant to technology can create barriers to change. Stakeholders also emphasised that it is particularly important to gain the support of Australian non-government organisations who are involved in the provision of services to older people, such as Blue Care, Baptist Community Services, Wesley Mission and Aged Community Housing. As noted in the study by Roelands et al described in Section 6.2, the views of caregivers, health and service professionals are often respected by older people and their encouragement can have an impact on the uptake of assistive technologies (Roelands et al., 2002).
7 summary and conclusions
7 Summary and conclusions

7.1 Trends in research

Overwhelmingly assistive technology research has been carried out overseas, particularly in the United Kingdom, Italy, Scandinavia, Canada and the United States. There is remarkably little material that explores the use and effectiveness of assistive technology in Australia.

Currently, the major trends in research focus on telecare, telehealth and smart home technology. There are some high quality studies in relation to less sophisticated technologies such as household safety devices, home modifications and mobility supports, and their capacity to increase functional independence (Mann et al., 1999), (Mann et al., 2004), (Chiu & Man, 2004).

The focus of current research is on the efficacy of technology. There is less research into the viability, logistics and costs of large scale implementation of these technologies. There is also very little comparative research and analyses on the models of care that might support assistive technologies, with the exception of the evaluation of the West Lothian project in Scotland by Bowes & McColgan (2006).

Almost all studies examining the effectiveness of assistive technologies are small-scale. There is a remarkable lack of studies involving more than one hundred people, and there are a limited number of randomised controlled trials both for simpler aids, appliances and equipment and more sophisticated remote monitoring technologies.

Telecare and smart home research is predominantly in the form of case studies, exploratory studies and some evaluations, mostly small-scale. A considerable part of the literature is at a descriptive stage, that is, simply trying to describe the capabilities of current technology rather than comprehensively examining its strengths and weaknesses on a systematic basis. There is very little material available which evaluates different models of telecare services against one another.

Telehealth research, which is only briefly examined in this study, is often highly technical and focused on improving the technology involved in remote health monitoring.

It is the authors’ view that industry providers are the primary drivers of assistive technology research, particularly in relation to remote monitoring and smart home technologies. Industry organisations particularly involved in research include Tunstall, NovitaTech and TeleMedCare. Although this research is often of a high quality, it does have an impact on the independence and transparency of the evidence available. Recently, governments have taken notice of the potential social and cost benefits of assistive technologies, motivating an international move towards participating in and commissioning assistive technology research. The drive to develop and implement assistive technology services on a broad scale, however, suffers from a lack of consumer pressure, primarily because older people and their families are largely unaware of the potential of assistive technology (Audit Commission UK, 2004: 28).

Recently, there has been a move towards researching the attitudes and opinions of older people to assistive technologies (Barrett, 2008), (McCreadie & Tinker, 2005). This research is only preliminary and predominantly in England, Ireland, Scotland and the United States. The TRIL Centre in Ireland is at the forefront of social research incorporating ethnographical studies of older people in order to comprehensively understand the experience of ageing and the ways in which technological interventions can support this process. There is also increasing research into the positive benefits of mainstreaming assistive technology to overcome feelings of stigma by users that may limit its uptake. Almost all stakeholders interviewed for this study emphasised that research into older people’s attitudes is very limited and is not being incorporated into the design of technological products. They felt strongly that the future of the assistive technology industry needs the inclusion of older people in research and in the design of products and services.

There is also increasing research into the capacities of assistive technology to improve communication and the social connectedness of older people, particularly as future generations of older people become more technologically savvy. This research is preliminary and in a descriptive stage. There is very little evidence available quantifying the promising aspects of assistive technology to increase social connectedness.
7.2 Gaps in research

A major finding of this study is that while there is a large volume of literature that explores the use of assistive technology there are many important areas where research is lacking. The main gaps in research identified in this study are set out below:

- **Australian specific studies** – there has been very limited research carried out in the Australian context. Assistive technology research in almost all areas explored by this study is lacking in Australia, with the exception of home maintenance and modification services which is the subject of research at the Australian Housing and Urban Research Institute (Jones et al., 2008).

- **Research involving older people** – in Australia and overseas the research on assistive technology frequently does not include older people as consumers of technology. Numerous stakeholders argued that there was a need for studies which place the ‘person’ at the centre of research, not the ‘technology’. Older people’s views and attitudes on technology need to be incorporated into technology design and development (Audit Commission UK, 2002: 31). This is critical to increase the uptake of assistive technology and improvement of design, effectiveness, usability and quality of devices. (Ghulam et al., 2007), (Mann et al., 2004: 5), (Barrett, 2008: 6). Research involving specific cultural and social groups of older people is also lacking. This is important if training and education programs are to be tailored to particular demographics, such as people in remote and rural Australia, Indigenous communities and people with non-English speaking backgrounds.

- **Research into the viability of large-scale implementation** – research into the large-scale deployment of assistive technology is minimal. Gaps in the research include how comprehensive assessment procedures for older people can be carried out, including follow-up home based training in devices and educational programs for carers. Gaps also exist in research around what physical infrastructure is required to support program use, for example, phone line placement, computer placement, storage areas, and regulation of 24 hour monitoring centres. Research is also lacking about how to address tensions between Commonwealth, State and Territory delivery plans.

- **Large-scale research** – there is a paucity of large scale studies involving more that one-hundred people. This paucity in research is particularly noticeable in relation to studies involving the effectiveness of particular technologies. Large-scale, integrated analyses of different types of assistive technologies, their respective effectiveness and cost would be useful to understand why some devices and systems fail and others succeed. Studies need to evaluate how the ‘care team’ operates most effectively and how the ‘loop is closed’. Ideally, these large-scale studies will include more randomised controlled trials.

- **Social impacts (intended and unintended)** – ongoing evaluation of the intended and unintended social aspects of assistive technology is largely absent. There are gaps in research about how assistive technology might increase social isolation if carer contact is reduced. There are also major gaps in research quantifying the benefits of assistive technology in improving social connectedness, through computers and other communications technology.

- **Research into access, information and assessment issues** – the authors identified minimal research material in relation to how older people can gain access, information and be assessed for assistive technologies in Australia.

- **Information about strategies to reduce costs and quantify outcomes** – there are gaps in research around ways to reduce costs for service users. The development of comparable outcome measures will also have an impact on how assistive technology research is to be compared and quantified. Currently, there is very little consistency in use of terminology and measurement of assistive technology outcomes.

- **International comparative policy analysis** – there are gaps in comparative policy research that examine the benefits and disadvantages of different models and their suitability to the Australian context.

- **Research into the impact of early intervention** – research establishing the importance of early intervention is under-developed. The research into how assistive technology can promote mental and physical health in the early stages of ageing is preliminary. In particular, research is lacking in relation to the preventative impacts of low-cost, less-sophisticated technologies.
7.3 Summary of findings

This scoping study has reviewed 110 publications, incorporating 74 pieces of literature into the narrative analysis and 16 studies into the Table of evidence. The study has found that high quality evidence (in the form of randomised controlled trials, systematic reviews, pre and post controlled studies and/or case studies), is not prolific in the literature on the use of assistive technology by frail older people in the community. However, the literature available is able to support key findings about assistive technology.

Effectiveness of assistive technology

In terms of the effectiveness of assistive technology, when appropriately prescribed and supported, this study has found that assistive technology can contribute to a number of positive outcomes for older people. The quality of evidence varies depending on the technology in question.

For aids, appliances and equipment, including bathing, cooking and mobility aids, there is strong evidence to support findings that assistive technology can enable:

- improved safety and reduced falls, accidents and hospitalisation (Mann et al, 1999), (Gitlin, 1998)
- improved independence, mobility and physical function (Mann et al, 1999)
- improved well-being and quality of life, particularly an enhanced sense of safety (Barrett, 2008).

The literature also indicates that early intervention may have an impact on the effectiveness of aids, appliances and equipment (Gosman-Hedstrom et al, 2002), (Gitlin, 1998).

For environmental adaptations, such as re-arranging furniture and installing hand-rail supports, there is very strong evidence (in the form of systematic reviews and randomised controlled trials) to support the finding that they can:

- reduce falls and hospitalisation rates, (Scott et al, 2001)
- improve physical function and mobility in the home, (Mann et al, 1999).

For remote monitoring, there is strong evidence (in the form of studies receiving a rating in the Table of evidence) that telecare can:

- reduce hospitalisation rates through providing prompt responses to accidents and enabling older people to return home earlier after a hospital stay (Joint Improvement Team, 2008), (Vincent et al, 2006)
- reduce the psychological burden experienced by caregivers (Vincent et al, 2006)
- increase social confidence of some older people who feel more confident about leaving their homes when they are wearing an alarm pendant (Brownsell et al, 2008), (Joint Improvement Team, 2008)
- improve older people’s sense of safety and enable certain older people to remain at home, deferring the need for residential care (Dunk & Doughty, 2006), (Joint Improvement Team, 2008), Bowes & McColgan, 2006).

For integrated systems, the research relating to all three categories of technologies described above is relevant. Integrated systems draw a range of technologies together to provide comprehensive support. The literature suggests that integrated systems can:

- improve safety, reduce falls and hospitalisation
- improve mobility and function
- improve older people’s sense of safety
- reduce the psychological burden experienced by caregivers
- improve many older people’s well-being and provide opportunities to remain at home rather than entering into residential care (Bowes & McColgan, 2006).

Human support

This study has found that all four categories of assistive technologies require human support to make them effective. This support has the greatest impact for aids, appliances and equipment when it includes assessment, the correct prescription and home-based follow-up training and maintenance. For remote monitoring and smart-home technologies to be effective they must be supported by a well co-ordinated and multidisciplinary care team.

As discussed in the study, the literature supports the view that assistive technology is not designed to replace human care or contact, even where the number of hours of carer contact is reduced. In the same way that human abilities can achieve things that technology cannot, technology can contribute to the quality of
care in different ways. Indicated in the literature is that carers are not able to provide assistance to older people twenty-four hours a day, nor is it always beneficial for older people to become reliant on other people for simple everyday tasks that the older people would prefer to do themselves.

**Barriers to the uptake of assistive technology**

The literature reviewed for this study reveals a number of major barriers that limit the uptake of assistive technology. These barriers include a lack of clear access and information points for people to learn about assistive technology and be properly assessed. The lack of follow-up home-based training and basic maintenance of technologies is a contributor to the abandonment of aids and devices. Other barriers include poor design and unattractive appearance of aids and devices. The unattractive appearance of many items compounds issues around self-image, feelings of stigma and denial about disability and ageing. Many stakeholders consulted during this scoping study emphasised that the design of technologies often lacks consideration of older people’s views, attitudes and tastes. The paucity of research involving older people is one reason why older people’s attitudes and tastes are not often considered in the design process. In addition, the literature identifies that many older people are apprehensive about the cost and affordability of assistive technologies.

**Enablers to the uptake of assistive technology**

The research indicates that the earlier assistive devices are provided to older people after an accident or incident, the more likely the person is to embrace the technology. Where service providers are able to normalise the use of assistive technology they have increased its acceptability to older people. If assistive technology becomes more ‘mainstream’, its acceptability is greatly increased (see Section 6.3.3: Mainstreaming and design). The support and encouragement given by families and health professionals is also very significant in many older people’s decisions to use assistive technologies (see Section 6.2: Human support). In summary, the literature on barriers and enablers suggests that strategies to increase and sustain the uptake of assistive technology include:

- improving and mainstreaming the design and visual appearance of assistive technologies
- addressing affordability of assistive technology
- clear points of access, information and assessment
- increased education about what is available
- the correct prescription of assistive technology
- increased research involving older people.

This scoping study has identified a number of strengths and major gaps in research about assistive technology. As Australia’s older population increases and more people become interested in exploring flexible options for care and self-management, assistive technology research will become an increasingly important and multidisciplinary field of inquiry.
references
8 References

References marked with an asterisk ( allotted for recommended reading.


Barry, M. (2007). Working with market forces, increasing awareness of Assistive Technology to a new audience, the LifeTec Queensland story.


Department of Health, UK. (1989) Caring for old people. HMSO.


Hanson, J. (2001). From ‘special needs’ to ‘lifestyle choices’: articulating the demand for ‘third age’ housing. In S. M. Peace & C. Holland (Eds.), Inclusive housing in an ageing society (pp. 29-54). Bristol: Policy.


Sutherland, Stewart (Chairman). (1999). With Respect to Old Age - Royal Commission into Long-term Care for the Elderly.


Wakerman, J., Humphreys, J., Wells, R., Kuipers, P., Entwistle, P., & Jones, J. (2006). Systematic review of primary health care delivery models in rural and remote Australia: Australian Primary Health Care Research Institute - Centre for Remote Health - Flinders University, Charles Darwin University, Monash University Faculty of Medicine, Nursing and Health Sciences University of Queensland.


Appendix A
Research tools
A.1 Selection protocol for research

<table>
<thead>
<tr>
<th></th>
<th><strong>Literature search and consultations</strong></th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Electronic search of all major academic data bases (including the Cochrane library). Internet searches done including searches of key websites. Publications identified through consultations. Hand search of relevant journals.</strong></td>
</tr>
<tr>
<td></td>
<td>Keep record of all searches done including key words used and keep a count of all relevant abstracts retrieved.</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Narrative review</strong></th>
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<tbody>
<tr>
<td>2</td>
<td><strong>This will incorporate ‘grey’ and ‘black’ literature found to date and consultation findings. Narrative review will also include background research into the:</strong></td>
</tr>
<tr>
<td></td>
<td>• broader social impacts of increasing assistive technology including the potential to increase isolation;</td>
</tr>
<tr>
<td></td>
<td>• variability of perspective identified in literature from stakeholders including frail older people with different types of impairment or disability, carers of frail older people, allied health, professional and non-professional workforces, industry, government including different levels of the Australian Government and governments from overseas, wherever possible;</td>
</tr>
<tr>
<td></td>
<td>• impact on resources: the extent to which assistive technology can and should replace existing human contact and services; and</td>
</tr>
<tr>
<td></td>
<td>• transferability of literature about assistive technology in the residential care setting and in relation to younger people with a disability to frail older people living in the community.</td>
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<thead>
<tr>
<th></th>
<th><strong>Synthesis</strong></th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>One reviewer applies inclusion/exclusion selection for the synthesis. Any previously unidentified literature found during the narrative review that meets the selection criteria included.</strong></td>
</tr>
<tr>
<td></td>
<td>Count of number of abstracts excluded and included.</td>
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</table>

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<thead>
<tr>
<th></th>
<th><strong>Publication details entered into table of studies.</strong></th>
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<tbody>
<tr>
<td>4</td>
<td><strong>Publication sorted into assistive technology type (type of intervention and/or type of technology. This will be determined through the review).</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>For each assistive technology type the following questions will be applied by one reviewer:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>• what do the combined research reports tell us about the intervention?</td>
</tr>
<tr>
<td></td>
<td>• do studies produce consistent results?</td>
</tr>
<tr>
<td></td>
<td>• is the body of evidence convincing?</td>
</tr>
<tr>
<td></td>
<td>• what does the body of evidence tell us about the assistive technology type?</td>
</tr>
<tr>
<td></td>
<td>• If the evidence tells us that the assistive technology type is effective, what were the factors that contributed to its success?</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th></th>
<th><strong>A quality of evidence rating applied to each assistive technology type. This will be done by one reviewer in consultation with a second reviewer where the evidence is unclear.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Quality of evidence scale will be based on the scale developed by the National Health and Medical Research Council (1999). However, the format of the scale will be adapted to allow inclusion of a broader range of ‘grey literature’ and qualitative studies as per the Rychetnik and Frommer (2002) schema for evaluating evidence in health promotion.</td>
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<thead>
<tr>
<th></th>
<th><strong>Table of evidence will be prepared (the draft format will be revised as determined by project findings).</strong></th>
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<tbody>
<tr>
<td>7</td>
<td><strong>Table of evidence will be prepared (the draft format will be revised as determined by project findings).</strong></td>
</tr>
</tbody>
</table>
### A.1 Selection protocol for research

**Narrative review and synthesis**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Inclusion</th>
<th>Exclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time period</td>
<td>2000 - 2008</td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>English only</td>
<td></td>
</tr>
<tr>
<td>Place of study</td>
<td>anywhere</td>
<td></td>
</tr>
<tr>
<td>Type of study</td>
<td>Any type</td>
<td></td>
</tr>
<tr>
<td>Relevance and scope</td>
<td>Frail aged (people aged over 65 years)</td>
<td>Younger people or adults with a disability</td>
</tr>
<tr>
<td></td>
<td>Assistive technology that enables functional independence of frail older people</td>
<td>Assistive technology related to health monitoring</td>
</tr>
<tr>
<td></td>
<td>Sophisticated assistive technology for which there may be barriers to uptake in terms of:</td>
<td>Simple, older, commonplace assistive technology which is relatively inexpensive and already accessible (such as tap turners, shower chairs, jar openers), without excluding low cost but high impact assistive technology.</td>
</tr>
<tr>
<td></td>
<td>• cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• familiarity and comfort with technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ability to use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assistive technology intended for use in primary care (home, in the community) and residential care (supported accommodation for frail aged)</td>
<td>Assistive technology used only within hospitals or other health care settings</td>
</tr>
</tbody>
</table>

**Synthesis only**

<table>
<thead>
<tr>
<th>Rigour of research methods</th>
<th>Well designed studies in which:</th>
<th>Poorly designed studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• the intervention is adequately applied in the research context.</td>
<td>Studies which are ethically compromised</td>
</tr>
<tr>
<td></td>
<td>• the evaluation research is convincing and reported effects are attributable to the evaluation.</td>
<td>Studies in which the results are not clearly attributable to the intervention/assistive technology</td>
</tr>
<tr>
<td></td>
<td>Included study types: process evaluation, randomised control studies, case control study, longitudinal study, pre and post evaluation, qualitative research, needs assessment research</td>
<td></td>
</tr>
<tr>
<td>Findings</td>
<td>The findings are applicable in the intervention context</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B
Assistive technology in the Australian community care context
B.1 Assistive technology in the Australian community care context

Figure 3 opposite provides an indication of how certain types of assistive technologies may be appropriate at different levels of community care. Aspects of the diagram may overlap. Certain types of assistive technologies, such as mobility equipment and communication aids will be determined by the specific needs of the older person, depending on when they experience the onset of certain debilitating conditions.

**Tier One**

Certain aids, appliances and equipment are appropriate at an early intervention stage as they can prevent falls and accidents which lead to general physical and mental decline. Home modifications can also have a preventative impact when they make an environment safer for a person who is susceptible to falls. Here, certain ‘daily living’ aids may be assist where the person has difficulties with certain tasks or finds it difficult to remember to turn off the stove.

**Tier Two**

Monitoring systems, such as alarms and reminders, may be appropriate when the person is quite frail or their care needs are driven by a health condition.

**Tier Three**

Integrated systems are suitable for people who have relatively high level care needs who may otherwise need to enter into residential care. They may be experiencing the onset of dementia, are generally disorientated by their environment or have a debilitating health condition that requires regular monitoring to detect risks around heart attacks and/or strokes.
Figure 3 – Tiers of care

AT TYPE

- Aids, appliances and equipment
- Environmental Adaptations

EXAMPLES

- Non-slip mats, re-enforced handrails, grips and handles
- Cognitive maintenance aids: specially designed computer, internet access and training where appropriate
- ‘Daily living’ aids to assist with cooking
- Home modifications to kitchen and bathroom to address ‘architectural disability’ created by the physical environment

TIER

- Tier One
  - Early intervention
  - Education
- Tier Two
  - Enhanced care
  - Early intervention
- Tier Three
  - Packaged ICT
  - Comprehensive dissemination

Environmental adaptations

- Monitoring

Integrated systems

Examples

- Environmental switches
- Tier one telecare – basic alarm pendant for older people susceptible to falls and/or with health conditions
- Tiers 2 and 3 telecare services with sensors and remote monitoring devices
- Smart homes which integrate telecare services, automatically: response systems, aids, appliances and equipment as well as home modifications such as new level lighting
Appendix C
Key websites and internet databases
C.1 Key websites and internet databases

Aged Care Australia (Department of Health and Ageing) - Aids and equipment for independence and safety. National portal provides an overview of kinds of assistance and contact details for local services and Independent Living Centres

Australian Rehabilitation and Assistive Technology Association (ARATA) - is an Association whose purpose is to serve as a forum for information sharing and liaison between people who are involved with assistive technology

Australian Research Council /National Health and Medical Research Council Research Network in Ageing Well – the ARC/NHMRC Research Network in Ageing Well is a national network of six universities and 50 researchers that conduct research into developing better health strategies to improve the mental and physical capabilities of older people

Carers Victoria (Series 1 Caring for an older person Sheet 12) - Factsheet on Aids and Equipment. Specifies need for proper assessment – refers carers to occupational therapists for equipment advice, physiotherapists regarding mobility aids, and speech pathologists for communication devices

Center for Aging Services Technologies (CAST) (US) – an international coalition of more than 400 technology companies, aging services organisations, research universities, and government representatives that develop and evaluate emerging technologies that can improve the ageing experience. It also offers the CAST Clearing House which is designed for and by technology developers, ageing services providers and researchers as a place to read about new products, research and pilot projects
http://www.agingtech.org/index.aspx

Council for the Ageing (COTA) – is a national peak body of leading seniors’ organisations, with individual members and seniors organisation members in all States and Territories
http://www.cota.org.au

Developing an Assistive Technology Evidence Base - This site is intended to foster an Evidence Base for assistive technology and promote Evidence Based Practice
http://www.assistech.org.uk/doku.php/evidencebase:evidence_base

Festival of International Conferences on Care-giving, Disability, Aging and Technology (FICCDAT) (Canada) - is a consortium of organisations, private and public, brought together under the leadership of the two originating Co-Chairs to maximise opportunities for collaboration between two social movements - ageing and disability conferences. The last conference was in 2007, and the next is scheduled for 2011
www.ficcdat.ca

Foundations for Assistive Technology (FAST) (UK) - a charity governed by a Board of Trustees is a small, independent organisation which focuses research on assistive technology in the UK
www.fastuk.org
Independent Living Centres Australia Inc.

International Association of Homes and Services for the Ageing (IAHSA) - is an international, not-for-profit educational
and charitable organisation with multi-national composition, both in governance and membership based in the US.
IAHSA has a global network of provider organisations, businesses, researchers, individuals and government officials with
representation in approximately 30 countries
http://www.iahsa.net/default.asp

Memorandum by Tunstall Group Ltd submission to the House of Lords Select Committee on Science and Technology
(UK) – this submission is about the use of technology and not about scientific developments relating to the healthcare of
individuals. It is about using technology to minimise the impact of the ageing process and to promote the independence
of individuals
http://www.fp.rdg.ac.uk/equal/

National Aged Care Alliance (AUS) - the National Aged Care Alliance is a representative body of peak national
organisations in aged care, including consumer groups, providers, unions, and health professionals, working together to
determine a more positive future for aged care in Australia
http://www.naca.asn.au

National Institute on Disability and Rehabilitation Research (US) - The NIDRR in the US administers a network of grantees
to provide information, training, and technical assistance to businesses and agencies with responsibilities under the
Americans with Disabilities Act

RehabTool.com (US) – is an information technology company that develops and markets hardware and software
integrated into solutions to assist individuals with disabilities and special needs. It also provides a comprehensive
overview of assistive technology categories
http://www.rehabtool.com/at.html#categories

Technology Research for Independent Living (TRIL Centre, Ireland) - is a research collaboration, jointly funded by Intel
Corporation and the Irish government, that is exploring technology to help older people remain independent and to
provide them with more options for ageing-in-place
http://www.trilcentre.org/

The Don Gnocchi Foundation - a non-profit charity with centres across Italy. http://www.dongnocchi.it/polotecnologico/
pl-ing_settori.htm funds the Research Department of the Don Carlo Gnocchi Foundation. Research areas include – bio-
signal analysis, neuro-motor research, ergonomic assessment, biophysics and nano-medicine
http://www.siva.it/eng/sivanel/milano/default.htm

The EQUAL Research Network - A UK-wide Strategic Promotion of Ageing Research Capacity Engineering and Physical
Research Council (EPSRC) funded Network for Extending Quality Life of Older People and Disabled People http://www.
fp.rdg.ac.uk/equal/ 13

The Rehabilitation Engineering Society of Japan (RESJA) - is an organisation concerned with application of science
and technology in the rehabilitation process. The Journal of RESJA publication is issued quarterly for clinicians in the
rehabilitation field
http://www.resja.gr.jp/eng/
Toronto Rehab Institute – is an academic hospital in Canada specialising in adult rehabilitation, complex continuing care and long-term care. They also conduct research into how technology can assist with rehabilitation
http://www.torontorehab.on.ca/research/index.htm

UK Department of Health National Health Service Purchasing and Supply Agency – the NHS PASA is an executive agency of the UK Department of Health. It administers the most effective purchase of health related resources by getting the best possible value for money when purchasing goods and services. The National framework agreement for telecare – Part A (including equipment, installation, maintenance, monitoring and response services) started in June 2006
http://www.pasa.nhs.uk/PASAWeb/Productsandservices/Telecare/NFA.htm

13. See for example SMART Rehabilitation research projects at http://www.epsrc.ac.uk/ResearchFunding/Programmes/Healthcare/EQUAL/EQUALConsortia.htm.
Appendix D
Table of evidence
D.1 Table of evidence

The Table of evidence presented below provides a summary of the systematic review carried out for this scoping study. A total of 110 studies were reviewed, of which 74 studies were considered relevant to be included in the narrative review (which forms the body of the report). Of the 74 studies identified as relevant, only 16 studies (listed in Table 6 below) were considered to be sufficiently rigorous to be included in the Table of evidence. The Table of evidence incorporates the findings from the 16 studies. Studies were only included in this summary if they were conducted with a sufficient level of rigour, as explained in Section 2: Method.

The quality of evidence rating is based on the NHMRC (1999) designation of levels of evidence scale, although qualitative studies were also included in the review and noted as such. As noted in Section 2: Method, the NHMRC (1999) levels of evidence have been adapted to include an additional rating (V) which refers to Expert opinion and well-designed exploratory studies.

Table 5 – Adapted National Health and Medical Research Council Designation of Levels of Evidence Scale

<table>
<thead>
<tr>
<th>Rating</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evidence obtained from a systematic review of all relevant randomised controlled trials.</td>
</tr>
<tr>
<td>II</td>
<td>Evidence obtained from at least one properly designed randomised controlled trial.</td>
</tr>
<tr>
<td>III-1</td>
<td>Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method).</td>
</tr>
<tr>
<td>III-2</td>
<td>Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case control studies, or interrupted time series with a control group.</td>
</tr>
<tr>
<td>III-3</td>
<td>Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group.</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence obtained from case series, either pre-test and/or post-test</td>
</tr>
<tr>
<td>V</td>
<td>Expert opinion and well-designed exploratory studies</td>
</tr>
</tbody>
</table>

The evidence rating applied to each of the categories listed below is based on the number and quality of available studies in that area. As a number of the studies included in this summary relate to more than one of the categories listed below, some studies contributed to the evidence rating applied to a number of categories. The categories for types of assistive technologies listed in column one are explained fully in Section 4: Overview of Types of Assistive Technology. The assistive technologies have been broadly grouped into four broad categories:

- aids, appliances and equipment
- environmental adaptations
- monitoring
- integrated systems

Each category is given a section in the table below. Where there is no rating given to a category an asterisk appears (*). Categories marked with an * indicate areas where the available studies to support that category were insufficient or unreliable. Accordingly, the * indicates areas where more research is needed.
### Table 6 – Table of evidence

<table>
<thead>
<tr>
<th>Types of assistive technology</th>
<th>Assistive technology support for older people living in the community</th>
<th>Quality of available evidence</th>
<th>Comments on evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of aids, appliances and equipment in prevention of falls</td>
<td>Role of aids, appliances and equipment in prevention of hospitalisation</td>
<td>IV</td>
<td>See above</td>
</tr>
<tr>
<td>Role of aids, appliances and equipment in increasing active and healthy lifestyle</td>
<td>Role of aids, appliances and equipment in decreasing dependency on caregivers</td>
<td>V</td>
<td>See: Barrett, L. (2008) Healthy@Home: AARP Foundation.</td>
</tr>
<tr>
<td>Role of aids, appliances and equipment in decreasing dependency on caregivers</td>
<td></td>
<td>*</td>
<td>More research required.</td>
</tr>
<tr>
<td>Social connectivity</td>
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<tr>
<td>Role of aids, appliances and equipment in supporting social connection</td>
<td>V</td>
<td>There is some preliminary research in this area including some research into the role of internet technology in supporting connectivity. See Barrett, L. (2008) Healthy@Home: AARP Foundation.</td>
<td></td>
</tr>
<tr>
<td>Role of aids, appliances and equipment in increasing social confidence</td>
<td>*</td>
<td>More research required.</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Wellbeing and quality of life</th>
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</thead>
<tbody>
<tr>
<td>Role of aids, appliances and equipment in increasing capacity to continue living at home: ageing in place</td>
<td>*</td>
<td>More research required.</td>
</tr>
<tr>
<td>Role of aids, appliances and equipment in increasing older adults sense of safety</td>
<td>V</td>
<td>Research in this area relates to feeling physically safer in everyday living, in areas such as falls prevention. See: Barrett, L. (2008) Healthy@Home: AARP Foundation.</td>
</tr>
</tbody>
</table>
## Supporting the uptake and use of assistive technology

**Aids, appliances and equipment must be supported by carers and other professionals to prevent abandonment of use (including training in the use of assistive technologies)**

| I | One systematic review emphasized the importance of formal training in the use of assistive technologies alongside equipment provisions but found that in general there is limited high quality research on the effectiveness of assistive technologies. Other studies found that assistive technology complements, rather than replaces, the role of carers, particularly with more complex technologies. See:  

**Timeliness of introduction of aids, appliances and equipment (assistive technology should be introduced soon after a stroke or other disabling event)**

| II | Most studies relating to timeliness focus on recovery from stroke. But the key point is that early introduction of assistive technology after a disabling event (within the first 3 months) increases the likelihood of uptake and continued use. One study found an association between decreased cost of assistive technology and early prescription. Other studies associated this likelihood with integrating the use of assistive technology into an individual’s adaptation to daily life following a disabling event. See:  
### Supporting the uptake and use of assistive technology

<table>
<thead>
<tr>
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<tr>
<td>Design of aids, appliances and equipment (need for the design and appearance of assistive technology to maintain people’s self image as independent and able bodied and avoid stigmatisation associated with use of assistive technology)</td>
<td>*</td>
<td>More research required.</td>
</tr>
</tbody>
</table>

**Mainstreaming**  
(consideration of ways in which aids, appliances and equipment can be applied generally so as to normalise use)
D.3 Environmental adaptations

<table>
<thead>
<tr>
<th>Types of assistive technology</th>
<th>Assistive technology support for older people living in the community</th>
<th>Quality of available evidence</th>
<th>Comments on evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of environmental adaptations in prevention of falls</td>
<td>I</td>
<td>See above</td>
<td></td>
</tr>
<tr>
<td>Role of environmental adaptations in prevention of hospitalisation</td>
<td>I</td>
<td></td>
<td></td>
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<tr>
<td>Ease of living, mobility and independence</td>
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<tr>
<td>Role of environmental adaptations in reducing functional decline</td>
<td>II</td>
<td>Studies looked at home environmental interventions provided with necessary support and training from an inter-disciplinary team including occupational therapists, nurses and technicians experienced in home modifications. See: Mann, W. C., Ottenbacher, K. J., Fraas, L., &amp; Tomita, M. (1999). Effectiveness of Assistive Technology and Environmental Interventions in Maintaining Independence and Reducing Home Care Costs for the Frail Elderly - A Randomized Controlled Trial. Archives of Family Medicine, 8, 210-217</td>
<td></td>
</tr>
<tr>
<td>Role of environmental adaptations in increasing active and healthy lifestyle</td>
<td>*</td>
<td>More research required.</td>
<td></td>
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<tr>
<td>Role of environmental adaptations in decreasing dependency on caregivers</td>
<td>*</td>
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<tr>
<td>Social connectivity</td>
<td>Wellbeing and quality of life</td>
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<td></td>
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<tr>
<td>Role of environmental adaptations in supporting social connection</td>
<td>Role of environmental adaptations in increasing social confidence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* More research required.</td>
<td>* More research required.</td>
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</tbody>
</table>

**Role of environmental adaptations in increasing capacity to continue living at home: ageing in place**

Studies looked at home environmental interventions provided with necessary support and training from an interdisciplinary team including occupational therapists, nurses and technicians experienced in home modifications. Evidence also shows a reduced financial burden on the health system associated with provision of assistive technology to support in home care and reduction of institutionalised care.

See in particular: Mann, W. C., Ottenbacher, K. J., Fraas, L., & Tomita, M. (1999). Effectiveness of Assistive Technology and Environmental Interventions in Maintaining Independence and Reducing Home Care Costs for the Frail Elderly - A Randomized Controlled Trial. Archives of Family Medicine, 8, 210-217

<p>| Role of environmental adaptations in decreasing depression | Role of environmental adaptations in increasing older adults sense of safety |
| * More research required. | * More research required. |</p>
<table>
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<tr>
<th>Supporting the uptake and use of assistive technology</th>
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<tr>
<td>Environmental adaptations must be supported by carers and other professionals to prevent abandonment of use (including training in the use of assistive technologies)</td>
<td>I</td>
<td>See: Mann, W. C., Ottenbacher, K. J., Fraas, L., &amp; Tomita, M. (1999). Effectiveness of Assistive Technology and Environmental Interventions in Maintaining Independence and Reducing Home Care Costs for the Frail Elderly - A Randomized Controlled Trial. Archives of Family Medicine, 8, 210-217</td>
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<tr>
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<td>*</td>
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</tr>
<tr>
<td>Mainstreaming (consideration of ways in which environmental adaptations can be applied generally so as to normalise its use)</td>
<td>*</td>
<td>More research required.</td>
</tr>
</tbody>
</table>
### D.4 Monitoring

<table>
<thead>
<tr>
<th>Types of assistive technology</th>
<th>Assistive technology support for older people living in the community</th>
<th>Quality of available evidence</th>
<th>Comments on evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td>Safety and Prevention</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Role of monitoring in prevention of hospitalisation</td>
<td>III-1</td>
<td>Reduced hospitalisation refers both to early intervention to reduce presentations at emergency departments as well as reduced length of hospital stays (due to increased capacity to receive care and monitoring at home). See: Vincent, C., Reinharz, D., Deaudelin, I., Garceau, M., &amp; Talbot, L. R. (2006). Public Telesurveillance service for frail elderly living at home, outcomes and cost evolution: a quasi experimental design with two follow-ups. Health and Quality of Life Outcomes, 4, 41-51.</td>
</tr>
<tr>
<td>Ease of living, mobility and independence</td>
<td>Role of monitoring in reducing functional decline</td>
<td>*</td>
<td>More research required.</td>
</tr>
<tr>
<td></td>
<td>Role of monitoring in increasing active and healthy lifestyle</td>
<td>*</td>
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<tr>
<td>Social connectivity</td>
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<tr>
<td>Role of monitoring in supporting social connection</td>
<td>* More research required.</td>
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</tbody>
</table>

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<tr>
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<tr>
<td>Role of monitoring in decreasing depression</td>
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</tr>
<tr>
<td>Monitoring must be supported by carers and other professionals to prevent abandonment of use (including training in the use of assistive technologies)</td>
<td>IV</td>
</tr>
<tr>
<td>Timeliness of introduction of monitoring (assistive technology should be introduced soon after a stroke or other disabling event)</td>
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<td>IV</td>
</tr>
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### D.5 Integrated systems

<table>
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<tr>
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<td>Integrated systems</td>
<td>Safety and Prevention</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Ease of living, mobility and independence</td>
<td></td>
<td>*</td>
<td>More research required.</td>
</tr>
<tr>
<td></td>
<td>Role of integrated systems in reducing functional decline</td>
<td>*</td>
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<tr>
<td></td>
<td>Role of integrated systems in increasing active and healthy lifestyle</td>
<td>IV</td>
<td>Smart home technology is effective in this area when accompanied by home-based support. See: Bowes, A., &amp; McColgan, G. (2006). Smart technology and community care for older people: innovation in West Lothian, Scotland</td>
</tr>
<tr>
<td></td>
<td>Role of integrated systems in decreasing dependency on caregivers</td>
<td>IV</td>
<td>Smart home technology enabled caring staff to perceive their role as one of ‘support person’ rather that ‘carer’.</td>
</tr>
<tr>
<td>Social connectivity</td>
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<td></td>
<td>Role of integrated systems in supporting social connection</td>
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<tr>
<td></td>
<td>Role of integrated systems in increasing social confidence</td>
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</table>
| Integrated systems must be supported by carers and other professionals to prevent abandonment of use (including training in the use of assistive technologies) | IV | Major study was on smart homes provided alongside home-based support.  
| Design of integrated systems (need for the design and appearance of assistive technology to maintain people’s self image as independent and able bodied and avoid stigmatisation associated with use of assistive technology) | * | See: Bowes, A., & McColgan, G. (2006). Smart technology and community care for older people: innovation in West Lothian, Scotland. |
| Mainstreaming (consideration of ways in which integrated systems can be applied generally so as to normalise its use) | IV | One major study mainstreamed smart home technology, making it available to all people over 60 in the area. This approach overcame stigma associated with asking for help or being identified as having dementia. Mainstreaming is also preventative, supporting people with undiagnosed symptoms of dementia.  
<table>
<thead>
<tr>
<th>Rating</th>
<th>Study citation</th>
</tr>
</thead>
</table>