New models of assessment and prescription of smart assisted living technologies for personalised support of older and disabled people

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Abstract

Purpose – *The purpose of this paper is to introduce an end-to-end process to improve the prescription, uptake and utilisation of assisted living technologies in order to improve outcomes for older and disabled people.*

Design/methodology/approach – *The approach involved consideration of the ways in which people's support needs are considered and how a more relevant picture can be drawn using their own goals and the issues and obstacles that prevent them achieving improvement. New models of support were introduced in order to improve the suitability of prescriptions for people who lived under different circumstances, sometimes with family carers.*

Findings – *It was found that the application of an enhanced assessment approach required professionals and family members to understand more about the range of available technologies and their limitations. In order to avoid rejection of the technology, there will be a need for service providers to extend the range of applications that they offer, and to consider the suitability of the home environment for introducing new systems.*

Practical implications – *The new model of assessment and prescription will improve the options for independent living for many people with minor disabilities and age-related problems.*

Social implications – *The correct use of assistive technologies will be improved leading to users having more confidence in the use of technologies to support independence in place of conventional and expensive care services.*

Originality/value – *The new model of assessment and prescription described in this paper is novel and developed by the authors as original work. Its value is that it disrupts current assessment schemes and will encourage innovation in prescription, and a more person-centred approach to satisfying the needs of vulnerable people.*

Keywords *Telecare, Assessment, Alarms, Assisted living technologies, mCare, Personalized technology*

Paper type *Viewpoint*

Introduction

As the population ages, and the likelihood of having family carers close by declines, support options for older and disabled people become increasingly limited. For the past decade or more, it has been the hope of service commissioners that technology would help support carers to provide care and support to people to help them live independently. Subsequently, there has been an increase in the number of people who have maintained their independence through self-care, often with the support of technology enabled care. Moving forward, continuing austerity and the resulting reduction in service provision by local authorities presents a barrier to

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accessing care-related services. This, together with an increased focus on the quality of domiciliary care provision and the need to pay care staff a fair living wage, is a major driver for an acceleration in the use of technology-based approaches to supporting people to live independently in their own communities. In such circumstances, it is imperative that processes are in place to ensure that technology is used appropriately, i.e. that it will enhance quality of life and offer better outcomes for users and their carers (and not just offer a lower cost option).

Unfortunately, neither the assisted living technology (ALT) industry nor the commissioners of services are yet prepared for this eventuality. Indeed, despite conventional aids to daily living and other mechanical support devices being available for several decades, their utilisation remains low, and many devices that are issued are not used consistently over an extended period of time. The situation with telecare and telehealth services is generally worse; few commissioners have extended the scope of services beyond alarms that detect problems such as smoke and floods in the home environment, and vital signs monitoring using expensive equipment used once or twice daily. The idea of an integrated approach designed to prevent accidents and actively support independence using mobile, video and other continuous telemonitoring applications both within and outside the home remains elusive.

Personal budgets and new priorities and responsibilities required in England by the Care Act, and also encouraged in the devolved nations of Scotland and Wales, will change the way in which support is offered. Direct payments and personal budgets, especially if they provide fewer people with sufficient funding to buy traditional services, will force older and disabled people to choose options that rely more on technology, and to use assistive devices themselves to avoid the need for hands-on care. The alternative could be more emergency admissions to hospitals and care homes, more avoidable deaths and a poorer quality of life. However, a greater use of technology will create a number of issues that will need to be addressed if personalised support is to become a reality:

- Formal assessments currently focus too much on activities that people are unable to do rather on what they want to be able to achieve for themselves.
- Both assessors and individuals (and their families) need to be made more aware of the range, capabilities and benefits of ALT.
- Members of the public need access to reliable, impartial and trusted information on ALT so that they can make an informed choice on the best solution to meet their needs and circumstances, taking into account issues such as features, cost, reliability and interoperability. This may be through an advocate or another source such as a website.
- People need to be aware of how they can access technology services, how they can choose between services, and how their needs may change over time.
- There must be a general understanding of the factors that may determine if and when a service or product will suit an individual and their circumstances taking into account issues such as telecommunications requirements and the level of technology literacy and support that may be required.

This paper addresses these issues and proposes ways of overcoming the challenges that they present.

Improving processes

People rarely enter the health and social care system unless they or their families recognise that they are having difficulties coping with living independently. In some cases, it follows an incident such as a period of illness, an inpatient hospital experience for surgery, the death or indisposition of a spouse or an accident. But for others, it follows a long period of slow decline which ultimately affects the way that they are able to perform everyday tasks, their employment, their leisure or the ways that they have previously coped with life's challenges. Under the former circumstances, decisions tend to be taken quickly, and without a full understanding of the options; this can lead to future regrets if they subsequently relearn some of their life skills and are then able to take care of themselves. There remain many examples of people who move out of their homes and into

residential care following a fall, or if their main carer becomes ill, because this approach appears as an immediately accessible means of managing risks – but often at the expense of a loss of long-term independence.

There are other options, including domiciliary care, meals services, day centres and visiting services that can compensate, in part, for some of these losses; technology can provide an ever-present means of support that can work alongside (and increasingly often instead of) other care provision to ensure that the solutions are robust and always available. However, assessments of unmet needs and risks to independence performed at (or shortly after) a time of crisis inevitably focus on the traditional agendas of care, shown on the left in Table I, rather than on a person-centred approach (see right column of this table). A more person-centred approach is consistent with the use of individually prescribed technologies and services that embrace the use of assistive devices, but which also consider an individual's interests, their abilities and their values. Unfortunately, the idea of promoting lower cost and more progressive options involving advanced technologies requires a cultural change both from individual assessors and from the general population who, without a far greater level of understanding, will be unaware of the enormous progress made in digital care products and how they can address-specific issues.

Telecare services have improved over the past 20 years, mainly as a result of providers recognising the importance of implementing individual response protocols that result in tailored interventions being made. Generally, these work well for people who live alone and who are housebound, especially if they have nominated responders who can offer help and support in the event of an emergency. However, there are increasing numbers of people who live with their spouse and are co-carers, as well as those whose families live far away and who are unable to provide a rapid physical presence when there is a perceived threat of illness or a sudden decline in condition. A model based on 24-hour monitoring centres may not be appropriate for many of these groups and for others who want to take advantage of broadband and mobile technologies that can provide a direct link to their loved ones. Services are now available that offer continuous monitoring of activity and which summarise the current status of an individual using a digital dashboard. This can be accessed anywhere in the world using a website or app and in the event of a potential problem, alert notifications can be generated using e-mails, text messages or app-based notifications. Video-based communication applications are also commonplace.

Furthermore, services that can only provide a reactive approach to the needs of users through the use of pendant alarms and sensors can focus too much on issues of risk and the early detection of adverse incidents. More importantly, by basing their operation on the use of alarm-based sensors, they are likely to miss the opportunity of offering a much wider range of assistive devices that can help people perform daily activities more safely. The use of appropriate aids to daily living and assistive devices that can help the user (and their carers) to perform domestic and personal tasks more safely can help to avoid such incidents from occurring in the first place.

It is our thesis that the limitations of conventional telecare services can be overcome by integration of equipment and the widest range of connected services. These should utilise both traditional (mainly mechanical) assistive technologies, adaptations to the home environment, and new and emerging technologies including wearable devices and ambient digital care applications enabled by Internet of

Table I Comparison of tradition and person-centred care

Traditional care approach	*Person-centred care principles*
Problem based	Plays to individual strengths
Focus on deficits	Aims to maximise quality of life
Based on facilities	Based in community
Episodic in nature	Empowers individuals
Reactive to emergencies	Relies on prevention and early intervention
Supports dependency	Encourages collaboration
Provision based on views of health and social care staff	Provision focuses on needs and views of service user

Things platforms. This approach requires a new end-to-end assessment and prescription process of the type shown in Figure 1 with regular and more frequent reviews (using automatic reporting when appropriate) to check that the technology prescription continues to meet the changing needs of the individual. It should also allow for temporary provision, both to deal with situations where family carers are away for a few weeks on holiday, and for periods following hospitalisation when people are often at their most vulnerable. Digital reablement should, in these cases, support restorative and intermediate care services. The details of the elements of our proposed new process are described below.

Understanding goals and ambitions of individuals

Moves towards consumer-directed care, and the use of personal budgets and resource allocation schemes, demand a more person-centric approach where the views, opinions, ambitions and desires of the service user are used as the basis of determining their requirements. It can help ensure that the outcomes will focus on quality of life and well-being rather than on making people dependent on services. This has resulted in novel and improved ways of performing assessments with some groups, such as people with learning (or intellectual) disabilities, with the result that the lives of many have been transformed; this is largely thanks to them being able to take control over their support arrangements. Furthermore, the review process is used to provide a check on progress towards their ambitions, enabling further interventions to be made to overcome any of the obstacles that have been delaying or preventing progress. The use of continuous monitoring of activities looking at room occupancy and, increasingly, through more specific use of appliances and items of furniture, enables families and commissioners to identify lifestyles and coping mechanisms. This is not possible through "moment in time" assessments that rely on basic performance indicators and judgements made by support staff based on incomplete data sets.

Some typical goals for older or disabled people are described in Table II which also shows how they might fit within Maslow's hierarchy of need. It may be observed that most of the examples are consistent with the higher levels of the hierarchy which generally lie outside the needs that local authority or health assessors would consider eligible for support and intervention. Indeed, in most rich and developed nations, the necessities of life, such as food, water, warmth, sleep, shelter, and clothing, and a right to safety, including having laws, police protection and a stable government, remain fundamental (levels 1 and 2, respectively). But in times of austerity, the right

Figure 1 A process for improved assessment and provision of full telecare services

Table II Requirements for services fitting into Maslow's hierarchy of needs

Examples of goals	*Maslow level*	*Description*	*How services might satisfy needs*
Feeling more comfortable	1	Physical needs	Providing necessities of life such as shelter
Feeling safer and less anxious	2	Safety	Providing protection and emergency support
More company and better relationships	3	Belonging	Helping to satisfy social needs
Having more family time	3	Belonging	Helping to satisfy social needs
Getting out more	4	Self-esteem	Facilitating feelings of achievement
More independence and choice	4	Self-esteem	Facilitating feelings of achievement
To continue to live in one's own home	4	Self-esteem	Facilitating feelings of achievement
Taking up artistic or musical interests	5	Self-fulfilment	Encouragement to achieve full creative potential

to help in satisfying higher levels of social need may no longer be available. This leaves some vulnerable people with little or no support to enable them to achieve a higher quality of life unless they are prepared to fund interventions from their own pockets or if they choose to use their personal budgets to buy more innovative services that can help meet their needs. It may be apparent that such options may be popular with service users and should, perhaps, be offered as new propositions by existing care and support providers, including those that offer telecare.

Extending these principles of choice to all older people may not be straightforward because those whose needs may be considered to be complex or critical may have relatively short life expectancies and, more importantly, may have recognised that they are not going to recover from a current crisis. Their ambitions may well be limited and, therefore, they may focus their attention on a need for physical attention and compassion, and practical measures to keep them safe, secure and free from pain, as well as warm, fed and watered. These factors may be more of a priority than interventions that can make them feel more content, entertained and motivated to take an interest in their lives and their surroundings. Assessment can, however, be achieved by considering an individual's ability to perform the instrumental activities of daily living, some of which are described in Table III.

Obstacles to achieving life goals and ambitions

People who have chronic disease, disabilities or other problems of old-age need to overcome various challenges in order to continue to live independently or to improve their quality of life. These issues include having money to pay for support services, and their ability to perform one or more of the activities of daily living described in Table IV.

They are fundamental to their dignity. Some obstacles can be overcome through traditional approaches including:

1. help from a family member or friend (informal care);

Table III Instrumental activities of daily living.

Activity	*Description and comments*
Doing light housework	Dusting, sweeping and cleaning using appliances such as vacuum cleaners
Meal preparation and management	Planning, buying food, preparation, cooking, washing up and clearing up
Performing personal laundry	Keeping clothing and bedding clean, aired, folded and stored
Taking medications as prescribed	Ordering and correctly taking a range of medications several times a day
Using telephone and communications	Answering the telephone and dialling numbers correctly at correct times
Caring for others and for pets	Providing support, food and reminders for family members or pets
Responding to alarms or alerts	Understanding and acting appropriately to important information
Managing finances and money	Ensuring that bills are services are paid for on time and competently
Transportation within community	Being able to get out and about to shops, parks and places of worship
Maintaining the home	Managing repairs, appliance servicing and decoration
Managing self-care	Keeping warm, eating and drinking appropriately, and responding to illness

Table IV The activities of daily living

Activity	*Description*
Dressing and undressing	Being able to change clothing as appropriate at least twice a day
Bathing or showering	Having ability to wash the body at least on a weekly basis
Toileting	Ability to get on and off a toilet or commode and to cleanse oneself
Feeding	Taking food from a plate or bowl, putting it in the mouth, chewing and swallowing it
Walking	Being mobile between relevant rooms in the house
Transferring	Getting up out of bed or a chair, and being able to sit or lie down

2. employment of a carer or care agency (domiciliary care); and
3. finding alternative ways of coping (but which may be carry significant risks).

It follows that the issues faced by individuals will depend intimately on their goals, on their personal family circumstances, their ability and willingness to pay for conventional care and support services and their knowledge of and confidence to accept risks to their well-being. Thus, whilst many long-term conditions and sensory impairments (such as hearing or sight loss) result in common and well-defined issues, it is necessary for professionals and for family members to consider them in the context of personal choices and priorities. These can change over time; someone who has recently returned home from hospital, or who is recovering from an injury, is likely to be at much higher risk of relapse during their rehabilitation. Similarly, anyone with a progressive neurological disease, including various dementias, is likely to experience an increasing number of issues which will become more and more difficult to manage using conventional services. In the same way, someone who lives alone may have additional issues relating to:

- Security – bogus callers, secluded property, poor locks, old windows, poor hearing;
- Safety – unstable on feet, poor vision, poor dexterity, old appliances, poor short-term memory;
- Loneliness – few friends, no family close by, housebound, sensory impairment, poor transport links;
- Lifestyle – smoking, use of recreational drugs, alcohol abuse, lack of energy, breathing problems, poor diet; and
- Anxiety – fear of being alone, poor sleep patterns, phobias, tendency to panic, perceived poor health.

In general, it should be possible, through discussion with the individual and their family members, to identify and prioritise a list of issues and risks. Sometimes, risks may be missed, exaggerated or dismissed. Where there is uncertainty, and when an individual lives alone for most of the time, it is possible to use continuous monitoring systems to provide a profile of activities over a period of a week or so. It follows that many conditions lead directly to issues that need to be resolved and Table V shows examples of issues that are relevant to some common conditions. These are not intended to be exhaustive but, rather, can serve to illustrate the need to use the profiling information collected through conversation or questionnaire, to define the issues before looking for appropriate solutions. In many cases, there may be comorbidities and multiple issues that need to be resolved. It follows that a complex range of ALT may be needed in most if not all cases.

As people become older, they are more likely to have long-term conditions that they will have to overcome for the remainder of their lives. Some conditions, or at least the symptoms associated with the conditions, can be managed through medication or through other therapeutic interventions. Many conditions limit the ability of the individual to perform certain activities. Similarly, advanced frailty can lead to falls, while cognitive impairments can lead to accidents and concerns for family members.

Models of support

It is often apparent from the issues that individuals face that many of them relate directly to their risk of an accident or illness or are risks associated with lifestyle choices or their coping strategies. In each case, the risks needs to be managed either by reducing the likelihood of an adverse

Table V Some health and disability conditions and possible issues

Stroke	*Low vision*	*Diabetes*	*Dementia*	*Learning disability*	*Frailty*
Speech deficit	Risk of falls	Risk of falls	Communication problems	Bogus callers	Risk of falls
Limb deficits	Bogus callers	Poor nutrition	Temporal orientation	Fire safety	Poor nutrition
Reduced mobility	Cooking accidents	Lack of stamina	Becoming lost	Social isolation	Reduced mobility
Incontinence	Social isolation	Foot care	Poor sleep patterns	Seizures	Home safety
Poor memory	Hygiene issues	Lack of exercise	Fire safety	Hygiene	Low strength

incident occurring or by reducing the impact of such an event. An effective means of supporting an improved outcome is through early detection and identification of an incident leading to an appropriate response. This could mean a conventional telecare system based on fixed-line telephony linking a dispersed alarm unit in the home with a 24-hour monitoring centre. This corresponds to situation 1 shown in Figure 2, and is ideally suited to someone who lives alone and rarely goes out unless accompanied. It is effectively the social alarm system (also known as teleassistance in Europe and a Personal Emergency Response System in North America) which has provided relief from anxiety for older people and their families for over 30 years.

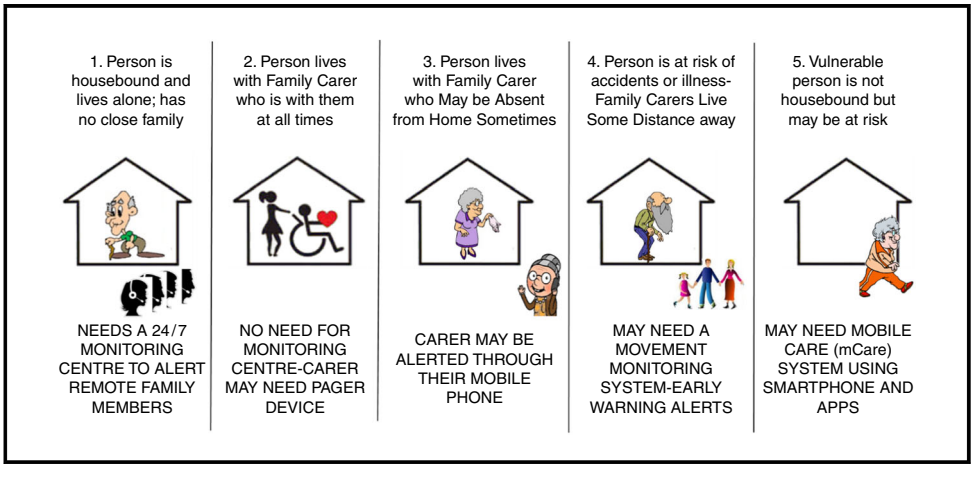
Social alarm systems have evolved into telecare services by the addition of smart sensors and the adoption of personalised response protocols. They continue to provide important support to vulnerable people and peace of mind to relatives. However, their essentially analogue nature means that they are not ideally suited to embracing advances in mobile and information technology. Furthermore, their requirement for a link to a 24-hour monitoring centre may be seen as an unnecessary intrusion by some groups. In particular, when a person lives with their family carer, who will inevitably respond to any emergencies detected by a sensor in the home, the role of a monitoring centre changes. This is the second situation described in Figure 2 and represents an application for "plesiocare" rather than telecare because the support is provided close by rather than at a distance. The sensors that may be relevant are similar to those used in situation 1, but need no longer connect to a dispersed alarm system but to a local alert notification system, such as a pager. This approach often results in a lower cost option, both in terms of the upfront cost of the equipment and on-going monitoring costs; however, their limitation is a lack of historical information on the nature and frequency of the alarms generated, which may offer an important insight in terms of preventing further problems.

In the same way, if the family carer sometimes has to leave their loved one alone, perhaps to go shopping or to go to work, they can be notified directly by programming the dispersed alarm unit to ring them or send them a message rather than using a monitoring centre. This is the third situation shown in Figure 2 and would generally use the same type of equipment in the home as in the first situation described above.

When the family lives some distance away from their loved one, they may choose to perform passive monitoring directly using internet-enabled services. These generally monitor movement and activity and employ exception rules that are set up specifically for that person. For example, a failure to enter the bathroom or kitchen during certain hours each day may indicate an alert, as might no use being made of the kettle, the microwave oven or the refrigerator. This type of need is described by the fourth situation in Figure 2 and may be enhanced through the use of video interactions.

Finally, the vast majority of older people, whether they live alone or with friends or relatives, will be encouraged to enjoy more time outside the home. It is recognised that the outdoors, exercise and

Figure 2 Different models of telemonitoring and how they are suited to different situations



opportunities for meeting with people will support well-being through relief of social isolation, as well as improvements in both physical and mental health. The concern that they may suffer an accident or illness may be managed by the use of a new range of mobile care (mCare) devices that may be carried with them at all times, as well as linked sensors that may be worn and specialist apps that provide interaction and support. These mCare applications can detect a range of problem situations including falls, periods of inactivity, convulsive seizures and becoming lost. This fifth care situation shown in Figure 2 is likely to become increasingly important as older people embrace the benefits of smartphones and mobile technology. This model of care could rapidly become dominant and provide attractive alternatives for all the scenarios in Figure 2, especially as access to the internet becomes ubiquitous and as telecare monitoring centres begin to support these services. In the meantime, it will be essential for assessors to consider which support scenario is most suitable for the potential service user.

It should be noted that all five scenarios relate to people living alone or with their carer. It may be apparent that many older people live as co-caring couples. Both may need monitoring so alarm systems may be relevant. However, current telecare systems do not allow the activities of two or more people living together to be differentiated from each other, and this is a limitation. The exception is personal devices such as worn alarms. Indeed, one of the biggest advantages of wearable devices is that they provide information at an individual level. It must be assumed that future systems, and especially those that employ mCare, will allow for more person-centred approaches.

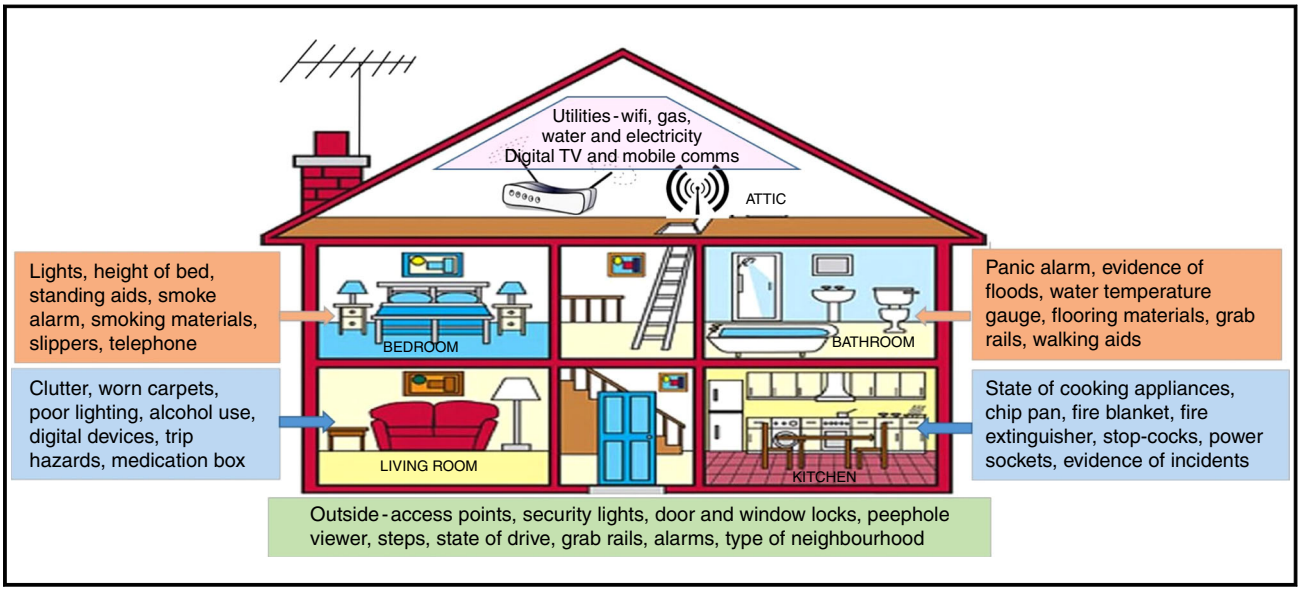
The home environment

With the exception of wearable and portable assistive technologies, other devices, adaptations and systems are installed and operate within the home. Consequently, the nature of the home environment is critical both in identifying how best to use technology to overcome presenting issues, and to finding other issues and risks that are related to this environment. A home survey should take into consideration areas where accidents are likely, Figure 3.

This includes the outside of the property and the bathroom which can be particularly hostile, the living room where the individual may spend most of their time, the kitchen where the risk of fire and cooking accidents is greatest, and the bedroom where accidents at night are also most likely.

The survey of the home is also necessary to identify the existing telecommunication capabilities and the state of the utilities. In particular, the availability of a working land line or broadband service is a requirement for nearly all telecare services. In the same way, mobile phone coverage

Figure 3 Hazards and utilities found in the home environment



is increasingly a requirement for many types of alarm service as well as for passive monitoring systems. The survey should therefore establish the most reliable mobile network providers for 2G, 3G and 4G services. It should be apparent that the survey will also provide an opportunity to consider trip hazards, existing assistive technologies (and whether they are used), the availability of power sockets in each room, and whether the electrical wiring and the plumbing infrastructure is suitable for the addition of additional electronic switch-off valves and for extended coverage if, for example, a downstairs toilet should be added, or if a stair or through-floor lift is required.

Increasingly, the provision of modern utilities and connectivity will become a responsibility of telecoms providers, often as part of expanded service offerings, or that of a social landlord. This should help to reduce the digital divide and overcome the problems present with some properties.

Local service availability

As the number of different technologies for supporting independence increases, it may be evident that there will be considerable variation in both the number and type of applications or services that are offered by individual service providers. Many aids to daily living are essentially standalone devices that can help meet an individual's goals or address the issues that prevent them achieving some of their ambitions. Others need to be linked either directly to other people, to the cloud for internet monitoring, or to a 24-hour monitoring centre. Assisted living service providers generally offer only a limited number of applications which means that opportunities for support may be limited according to where people live, i.e. there could be a post code lottery. Assessors need to be aware of which services and applications are offered locally. A non-exhaustive list of applications is provided in Table VI. Some applications, such as the provision of standalone devices and 24-hour monitoring, may be provided by a national provider. However, a local presence may be needed for installation, maintenance and for emergency response.

Individuals may need to choose several providers in order to satisfy all their needs through technology. However, local authorities may also see a worthwhile business opportunity in supporting a regional provider to offer the whole range of ALT and services and might also aim to stimulate this market to create healthy competition.

Table VI Examples and descriptions of a wide range of assisted living technology applications

Assisted living applications	*Examples or description*
Home adaptations	Level access shower; bath hoists; stair lifts; grab rails; ramps
Basic social alarm	Panic pendant and telephone unit linking to 24-hour monitoring centre
Alarm telecare	Social alarm with smart sensors and personal emergency response protocols
Proactive calling	Regular automated or actual telephone call to provide reassurance and monitoring
Digital reablement	Temporary provision of connected support services following accident or illness
Home activity monitoring	Remote collection, processing and display of activities with exception alerts
Falls prevention/management	Personalised devices and interventions to reduce fall incidents and impacts
Dementia support	Range of individual memory and behaviour management devices to reduce harm
Learning disability	Remote support to improve safety and opportunities for independence
Physical disability	Standalone and connected devices to help overcome mobility and limitations
Sensory disability	Sensors, apps and systems to help overcome limitations of poor sight or vision
Communication disability	Devices and systems to provide augmented speech options for users
End of life care	Telehospice service with monitoring, pain relief and remote spiritual care
Enhanced security	Range of connected and standalone devices to detect and deter criminals
Video interactions	Remote consultations and conferencing using TV or other technologies
Reminiscence service	Range of photographic, videos and music to inspire people with dementia
Vital signs monitoring	Telehealth to support people with chronic diseases such as CHF and COPD
Carer support	Plesiocare systems to provide support for family carers of children or older people
Teleconcierge	Remote monitoring of front door with control over admission
Carer respite	Temporary support systems to manage risks when carer is on holiday
Mobile activity tracking	Wearable devices and/or apps to collect data on daily levels of movement
Remote identification	Portable or wearable device to be used in case of emergency
Environmental controllers	User interface/switches to enable disabled persons to operate devices, doors, etc.

Likelihood of rejection

Despite the many benefits that ALT can offer, and the enormous potential for increasing independence while reducing cost, there will remain many people (and their families) who will either decline options relating to the use of technology, or reject them as being unsuitable after a short period of time. Significant effort and expensive resources can be wasted both prescribing and installing equipment and in training people how to use it. It would be beneficial to identify those who are unlikely to use or appreciate such technology at the earliest possible stage of assessment so that alternative provision can be made or coaching provided.

The technology acceptance model attempts to model how users accept and use technology primarily in relation to its perceived ease of use and its perceived usefulness. This was extended to include subjective norms but could only explain about 40 per cent of a system's use when applied to information technology, implying that the model failed to take into account a number of significant factors. The same approach has been used to examine motivational and cognitive factors associated with the use of telecare services and, more recently, the humanity perspective of psychosocial factors and their impact on acceptance. The conclusion that both self-determination and planned behaviour theories were effective predictors of future adoption amongst older people implies that the important factors are:

- autonomy and freedom of choice;
- feelings of being connected to others;
- a positive attitude to the use of technology; and
- the support of family and friends as a norm.

This helps efforts to promote the use of technology, but may be limited in predicting who may ultimately make use of the systems and services. On the other hand, the University of Cumbria has developed a five-point model for selecting patients for a telehealth programme and determining which products or services are appropriate. The points are:

1. Clinical/social suitability – relating to complexity of condition and likelihood of finding a complete solution.
2. Access and connectivity – this refers to whether the individual has chosen to receive connected services (i.e. broadband or fast mobile) rather than whether they are available.
3. Activation for self-management – relates to the individual's ability and willingness to take responsibility for their own self-management, through having the appropriate attitudes, skills and self-confidence. It is related to the concept of health literacy, but focuses more on the patient's "ownership" of their condition and their relationship with health professionals.
4. Health literacy – this is the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.
5. IT literacy – this may be an increasingly important component in defining suitability, especially if they need to interact with a computer, a website or sophisticated hardware.

It would be impossible to produce a definitive prediction tool that covers the use of all ALT without many years of testing and refinement. However, Table VII describes 12 factors that are likely to be relevant. They are offered as a series of questions along with comments on their potential influence. For simplicity, we suggest that if an individual scores a "no" for 6 or more of these questions, then they are more likely to reject or stop using the technology at an early stage. The list of questions could be expanded for specific technologies or user groups.

Service prescription

It must be assumed that every person being assessed will need to overcome a number of issues and manage several risks. They need to be prioritised in order to ensure that they are offered

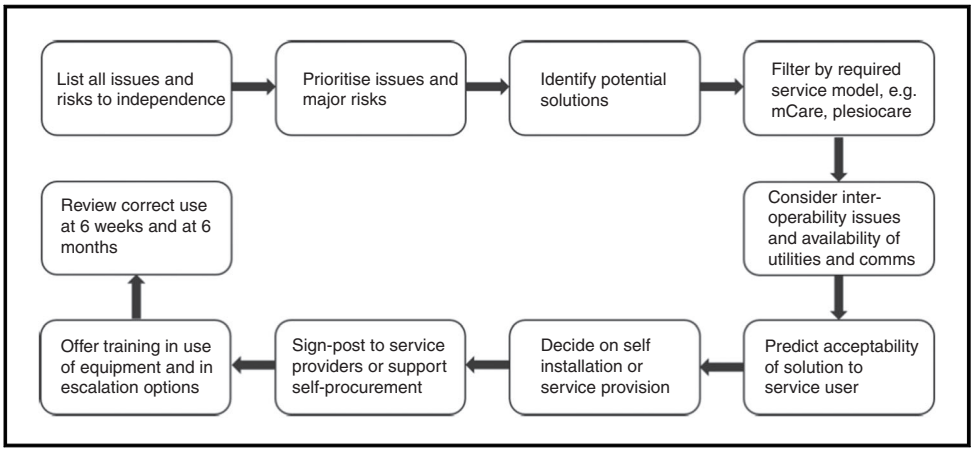
Table VII Questions to determine the likelihood of assistive technology acceptance

Question	*Comment*
Are they keen to be independent and in their own home?	If they are not motivated to help themselves then they will not appreciate the role of technology
Do they have a family that supports their autonomy?	If family neither wants them to be independent nor is willing to help, there is little role for technology
Are they able and willing to pay for their equipment and service?	The potential savings due to technology may not be appreciated if they are not going to pay
Are they frequent and confident users of the telephone?	The telephone is the most ubiquitous item of connected technology and may indicate confidence
Do they have and use a mobile phone or a computing device?	Individuals who choose not to use these everyday devices may not be willing to try new technology
Do they have smoke AND carbon monoxide (if applicable) alarms fitted?	Indicates acceptance of the risks associated with independence and a willingness to manage them
Do they already regularly use assistive devices such as a walking stick or hearing aid, and understand what they are for?	Although each item of technology is different, the use some of the most popular devices implies that they accept the principles involved
Are they free of complex multiple conditions with lots of issues?	Someone with comorbidities may be depressed and unwilling to consider ways of improving their lives
Would they think it reasonable to switch off all electrical devices at night?	Those who switch-off power at night may disregard advances in technology over the past 25 years
Would they be prepared to accept domiciliary care?	Some do not understand their vulnerabilities and reject all help
Do they have and are they able and willing to use central heating to keep their home warm?	A rejection of this fundamental technology would suggest an unwillingness to use assistive living technology systems
Do they worry about data security or digital privacy issues?	An expressed concern about how data are stored may become an excuse for rejecting digital devices

a system which will keep them safe and give them an opportunity to improve their quality of life. Figure 4 describes the process that may be employed to select appropriate solutions and then build the service required to provide, install and maintain the relevant elements.

Self-care may be appropriate for many younger and more active people, and they may enjoy discovering new products that could help them to address the issues that they recognise in their own lives. Similarly, family members will be expected to support their older relatives in the selection of appropriate service elements, and then in their installation, monitoring and response. However, many older people will have no close family and, especially when the issues that are obstacles to their independence appear suddenly, they will rely on advocates to help them find the most appropriate solutions. It is therefore essential that these advocates are fully aware of all the options that include technology and that they are eager to take a whole of market approach in giving their advice.

Figure 4 A process to support the appropriate prescription of assisted living technologies



Occupational therapists are well-placed to manage the prescriptions based on their experience and expertise in understanding people's physical and cognitive deficits and needs and in finding conventional assistive technology solutions supported by factsheets and other resources provided by organisations such as the disabled living foundation. However, their knowledge of digital caring solutions is likely to be more limited, both because they were not included in university training courses and because the communications technologies on which many are based may lie outside their comfort zones. Fortunately, the Vivo guide (vivoguide.co.uk) provides independent and impartial advice for the public and professionals, enabling them to discover solutions and to compare performance.

There are now many different organisations offering ALT either through catalogues and mail order or over the counter in pharmacies. However, the greatest growth has been in websites which can offer a service direct to the customer wherever they happen to live. Many work in partnership with existing telecare service providers in order to offer monitoring and similar service elements. Increasingly, third sector organisations may play an important role in offering a retail service backed up with their independent and trusted brand. These organisations will focus on supplying people with particular conditions, such as Alzheimer's disease, or family carers (e.g. the carers trust). Their presence in the market will provide a welcome boost to the acceptability and popularity of technology solutions.

Concluding remarks

Assisted living technologies have come a long way during the past 20 years. Manufacturers are beginning to design products that are both functional and aesthetically pleasing. Many are also smart and capable of communicating with other devices enabling more intelligent behaviour and ensuring that many of the issues associated with independence can be managed in a way that is tailored to the needs of the user. Alarms are no longer restricted to panic pendants monitored by call centres but include a range of devices that are tailored to individual circumstances and family support mechanisms.

The plethora of choices makes it difficult to prescribe the optimum package of support for anyone, which means that more consideration must be given to assessment processes from identification of goals, obstacles and risks through to the compatibility of products with the home environment, the user's preferences and the limitations of digital telecommunication options available in their property. Ultimately, the use of technologies beyond the first week or two by some people can be low, and these individuals need to be identified before resources are committed. Attention to the processes described in this paper may lead to more people benefitting from an extended use of ALT.

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