



Training course Senior Service Worker

Ambient assisted living services in home care and community based settings for the elderly

Ambient assisted living solutions for the elderly

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3. Ambient assisted living solutions for the elderly

Sensors and data recording

Sensors (e.g. measuring motion or blood pressure) are often at the heart of AAL systems, since they monitor a user's well-being and detect critical situations that prompt the system to take action (e.g. detecting a fall prompts an emergency call). When installing sensors in people's homes, the following aspects should be considered (Flick, 2012):

Types of sensors: While motion sensors (e.g. PIR) or contact sensors (for doors etc.) are widely accepted among users, the usage of cameras or microphones is less favoured. If cameras or microphones need to be installed, placement is another critical aspect of acceptance (e.g. in the living room, but not in the bathroom). Regarding motion sensors, project teams should consider that seniors – especially those who live alone – might have pets at home that could interfere with a system's detection.

Installation of sensors: Drilling holes in the wall or laying cables for connections are not a major obstacle for most users (but can be avoided by using wireless technology). They usually find it more important that they can use a system in the place where they already live, since they are usually not willing to move to another home just to use AAL solutions. However, it is recommended that aesthetic aspects be considered, and that sensors be attached unobtrusively (in line with the idea of an 'ambient' system). Ensure that the implementing electricians share this notion if system installation is done by third parties rather than project members.

Privacy: Besides the normal ethical considerations regarding data management, many senior end-users would want to receive feedback on the collected data (e.g. in terms of an activity profile) or data retrieval (e.g. by their relatives). Data transfer to relatives must be checked with the target group, as some users would not accept this, while others would agree to the transfer of specific data (e.g. emergencies only rather than information on activity patterns). It has also been found that some seniors only want to use AAL solutions to share positive experiences with their relatives, while not disclosing problems or negative emotions.

Accuracy: The tolerance of an emergency system giving false alarms by senior end-users is less than 10 incidents per month (acceptance is especially low at night). If the choice was between longer recognition intervals and more false alarms, the preference is for longer time

intervals. The validation of detected emergencies via telephone could be an accepted option to deal with this. However, seniors' expectations of other detected events' accuracy (e.g. motion-driven lighting) might differ and should be checked individually.

3.1. Ambient assisted living services

3.1.1. Telemedicine:

The use of telecommunication and information technologies to provide clinical health care. This includes the transmission of medical, imaging and health informatics data from one site to another. It is a valuable resource for the delivery of medical training and emergency and critical care incidents occurring in remote locations. In the early 1960s, the practice of medicine through telecommunication began when the National Aeronautics and Space Administration (NASA) first put men in space. Astronauts' physiological measurements were telemetered from both the spacecraft and the space suits during NASA space missions. The development of satellite technology enhanced these early efforts and promoted the advancement of telemedicine. In 1980, following a powerful earthquake that struck the Soviet Republic of Armenia, NASA extended an offer of medical consultation to the Soviet Union. Telemedicine consultations were conducted using video, audio and facsimile between a medical centre in Yerevan, Armenia and four medical centres in the United States. As technology has improved and the cost of equipment continues to decrease, the use of telemedicine has become increasingly prevalent. The top five types of consultations include: mental health, emergency and trauma care, cardiology, dermatology and surgery.

The scope and sophistication of applications have developed considerably over the last 25 years. These can be classified into four generations of telecare

First generation: Equipment that forms part of most community alarm services. User-activated alarm transmits calls (by push button, pendant or pull cord) to a control centre where a call handler can organise an appropriate response

Second generation: More advanced and automated social alarm systems such as smoke, fire and flood detectors. There is no need for the resident to trigger an alert

Third generation: Most advanced telecare devices that automatically record everyday data through various sensors such as front door open/close detectors, fridge open/close detectors, pressure mats, bed/chair occupancy and electrical usage. Data is analysed on a regular basis to monitor wellbeing and assess the need for increased help and support.



Fourth generation: Mobile phones and GPS systems enable traditional home based telecare services along with visual communication between older people and their carer and/or family members.¹

3.1.2. Telecare

The remote or enhanced delivery of health and social care services to people in their own home by means of telecommunications and computer-based systems.² Telecare is a service that enables people, especially older and more vulnerable individuals, to live independently in their own homes. In the United Kingdom, the Whole System Demonstrator Action Network (WSDAN) estimated that in 2010 between 1.6 million and 1.7 million people in England were using some form of telecare, predominantly pendant alarms. The scope and sophistication of applications have developed considerably over the last 25 years. Today, technology has the ability to incorporate environmental and personal sensors in the home. 24-hour monitoring ensures that should an event occur, the information is acted upon immediately and the most appropriate response is put into action. Telecare is not a solution in isolation. Although telecare can reduce the need for supervision it should not be used as an alternative to direct care. It is most effective if used as part of a package of support that is accepted by the individual and their formal and informal caregivers.

Effective telecare requires:

- Personalised outcomes with focused assessment of needs and risk
- Consideration of ethical dilemmas (such as capacity, informed consent and choice)
- Training and education for all involved in how the equipment can be used and maintained

3.1.3. Telehealth

The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of diseases and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of

1 - Deloitte Centre for Health Solutions (ADD Year) Primary care: Working differently: Telecare and telehealth – a game changer for health and social care. Deloitte: London

2 - Barnes N M et al (1998) 'Lifestyle monitoring : technology for supported independence' IEEE Computing and Control Engineering Journal, vol 9, no 4, pp 169-74



advancing the health of individuals and their communities. Telehealth has been practiced since antiquity using primitive communication technologies to prevent the spread of infectious diseases. For example, individuals with leprosy used to ring bells to warn others to keep away. Ships carrying the bubonic plague flew yellow flags to indicate they were in quarantine. Today exchanging information about our health is a basic custom. We greet each other with “How are you?” or “How do you do?” The formal emergence of telehealth was thought to have begun in 1897, when the telephone was used to diagnose a child with croup. The case was reported in the medical journal *The Lancet*³

Modern telehealth provisions are emerging in a number of countries, providing remote monitoring of a patient’s vital signs through various devices. Information is transmitted to a response centre where the clinician can monitor and interpret the data. In the United States, the Veterans Health Administration (VHA) has implemented and assessed a major Home Telehealth programme to enhance access to care nationwide. In 2011, 50,000 VHA patients received telehealth services, and the service is projected to grow substantially.

3.1.4. mHealth (mobile health)

mHealth is the utilisation of mobile phones, tablets and PDAs (personal digital assistants) in delivering health and social care.

Patient-centric care or “care anywhere” is becoming a reality. Mobile healthcare (mHealth) is “the biggest technology breakthrough of our time”⁴, particularly in remote communities and/or countries where there is a very uneven distribution of medical resources. The growing interest rests on the assumption that two rising trends; (1) the increased availability of low-cost handsets and the penetration of mobile phone networks globally, and (2) the critical need to transform healthcare provision, will inevitably meet. When they do, the impacts will be profound. In 2013, it was estimated that 6 billion people had access to mobile phones, and that 64 per cent of all mobile phone users could be found in the developing world. A study revealed that 59 per cent of 433 doctors and 345 executives of payee organisations

3 - Darkins A W and Cary M A (2000) *Telemedicine and Telehealth: Principles, policies, performance, and pitfalls*. Free Association Books: London

4 - US Health and Human Services Secretary, Kathleen Sebelius in her keynote address at the 2011 annual mHealth Summit in Washington, DC area.



believed that mHealth would be widely adopted in the near future, whilst 48 per cent of 1,027 patients believed it would improve the quality of the healthcare they receive.⁵

3.1.5. Challenges to widespread adoption of telehealth and telecare

A key difficulty regarding the widespread adoption of tele-health and telecare services can be attributed to the attitudes of both professionals and patients who remain sceptical of the benefits such services can deliver. Positive outcomes have been reported in a number of evaluation studies into telehealth and telecare interventions. Results included improved clinical outcomes and users experiencing increased satisfaction with health and social care services.⁶ Nevertheless, a number of studies have reported unsuccessful implementation and adoption within routine healthcare services. Recruitment difficulties have also been an issue for evaluation studies. Reasons patients gave for not joining trials included being too busy, discomfort with the technology, belief that the technology could not help them and a preference for face-to-face consultations.⁷ Community nurses, paramedics, general practitioners, consultants and particularly patients themselves are the crucial tools in the successful adoption of telehealth. The more experienced people become in analysing and acting upon the data the technology provides, the more the services will become integrated, patient focused and cost effective. Raising awareness amongst health care professionals is still needed. Telehealth involves complex changes and integration. It is not just about technology but significant changes in work processes and reconfiguration of existing practices and relationships. The integration of telehealth and telecare practices into new care trajectories is essential.

5 - Vital Wave Consulting (2009) mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World. UN Foundation-Vodafone Foundation Partnership: Washington, D.C. and Berkshire, UK

6 - von Wangenheim A et al (2012), User Satisfaction with Asynchronous Telemedicine: A Study of Users of Santa Catarina's System of Telemedicine and Telehealth in Telemedicine and e-Health, Vol 18 No 5 pp339-346

7 - Sorensen J F (2008) Attitudes towards telehealth use by rural residents: a Danish survey in Journal of Rural Health: 24 (33) pp330-335



3.2. Online health and well-being services

The term “holistic care” refers to caring for the whole person in terms of their physical, psychological, social and spiritual needs. Many health and social care organisations, including voluntary organisations, now offer online self-help support services to help people manage long term conditions, mental health challenges such as anxiety, depression and stress and make healthy lifestyle choices. These programmes can help people to understand the way they react and respond in certain situations by supporting the learning of new coping techniques, development of self-awareness, challenging negative thoughts and improving moods. Online services can also have a role in supporting caregivers. Older people with dementia typically require some type of informal care, but caregivers can be put under particular pressure through issues such as the challenging behaviours they may encounter.

eHealth encompasses three main areas:

- a. The delivery of health information, for health professionals and health consumers, through the internet and telecommunications.
- b. Using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers.
- c. The use of e-commerce and e-business practices in health systems management.⁸

Social media

The use of social media can contribute to health and wellbeing, and is already being used by health and social providers and people with chronic conditions to exchange information. Individuals are easily able to broadcast their experiences and opinions about care services, drugs, devices and treatments as well as coping strategies in managing their chronic condition or disability. In recent years the rise of social media networks has been phenomenal, growing from 5 per cent of all adults in 2005 to one in four participants worldwide, an estimated 1.73 billion people, in 2014.⁹ The number of older people using the Internet is increasing. For many, the benefits of using the Internet include not only the ability

8 *Source: WHO: eHealth accessed at <http://www.who.int/trade/glossary/story021/en/>*

9 - eMarketer (2014) Worldwide Social Network Users: 2013 Forecast and Comparative Estimates accessed at <http://www.emarketer.com/Article/Social-Networking-Reaches-Nearly-One-Four-Around-World/1009976> on 9th February 2014



to keep in touch with family and friends through social media technology but also to improve their mental alertness and physical health through the use of video games. Studies have shown that playing video games helps improve cognitive functions which typically decline with ageing even if the person does not develop a neuro-degenerate condition such as dementia. Games specifically for older people are now being developed by the gaming industry who considers this section of the population their highest next target market in the future.

Barriers to digital inclusion for the elderly

Although information and communications technology is being used as a mechanism for delivering public services, older people are significantly less likely to access the internet than the general population. The “digital divide” is a term coined to describe the difference between those who enjoy access to the Internet and those who are excluded. When asked about their reason for not having an Internet connection, lack of interest was the most cited reason. The digital inclusion of elderly and disabled people is important for the development of assistive living technologies, particularly digital participation services such as telecare, telehealth and social media services. Main factors hindering the digital inclusion of older and disabled people include:

1. Lack of knowledge regarding the relevance and value of Internet use.
2. Lack of skills and confidence necessary to use a computer to access the Internet - Helpline services designed specifically to help older people with limited ICT skills should be made available.
3. Cost of equipment and/or broadband connection required.
4. Affordability which has given rise to discussions both in the EU and the United States on the need to encourage more frequent Internet use through special tariffs to low income families.¹⁰

Governments across the world have been urging private companies to embrace “web accessibility”. This is a broad-ranging concept that captures techniques to make the web usable for people with visual, auditory, mental or physical impairments. Involving older people and those with disabilities in the design of new devices would also be a key way of increasing awareness and ensuring accessibility issues are addressed.

10 - Lewin D et al (2010) Assistive Technologies for Older and Disabled People in 2030



3.3. Smart Home Technology

Many research labs have investigated in smart home technology. Several pilot projects employing the smart home concept have been explored and developed with the aim of improving the quality of life and promoted independent living of elderly persons by using advanced sensor and network technology. The European Commission has funded a number of research projects to help with the growing number of elderly population in Europe- These projects have been developed to determine how ICTs can meet the needs and maximise the potential of older people.

Smart home network

A smart home incorporates a communication network in order to control or monitor appliances or services within the home. Smart home network technology can be classified by interconnection method into three main types: wire, wireless and both wire and wireless.

- 1) *Wire*: Appliances and services in smart home are connected through wiring system such as optical fibre or cable. In this system, devices are normally connected directly into the main power supply.
- 2) *Wireless*: Many of new smart home appliances use wireless communication technologies such as infrared and radio frequency (RF). As radio wave can penetrate through walls, floors and cabinets, devices within smart homes can communicate wirelessly.
- 3) *Both wire and wireless*: Some of smart home network standards can work using both wire and wireless technology.

Smart home appliances

Smart home appliances are intelligent artefacts that enhance human way of living in terms of convenience, safety, etc. Below some of the most common and important appliances are listed, like:

- 1) *Cooking hob and oven safety control*: Many of the elderly people have a condition of forgetfulness in which safety and security of a person is reduced. Hobs and ovens are kitchen utensils regular used for cooking. Elderly person may easily forgets to switch the hob and oven off after finish cooking, especially electrically ones which is harder to notice.



Forgetting to turn off these cooking tools create dangerous environment i.e. potential cause of fire, injury from accidentally contact. Hob and oven safety control have temperature sensors to control the heat of the hob or oven and cut off the power if the heat reaches the safety limit.

2) *Sleeping pattern monitoring*: A bed is equipped with sensors which can detect the presence, respiration, pulse and movement of a person in bed. A sleeping pattern monitoring can be used to detect health condition regarding sleeping such as restless sleep, rapid change in activity level or unusual change in typical routine of a person. For example a person who normally gets up early but on a particular day tends to be lying in. This may indicate that the person may have a serious illness or incident causing the person unable to move. Another example is during the night, a person is detected to leave the bed but has not returned for some times, this may indicate that the person may have accident or is in emergency situation.

3) *Smart beds*: A smart bed, equipped with sensors to detect pulse, movement, respiration and presence, will be a hugely beneficial weapon in the elderly care arsenal. Monitoring the physiological aspects of the patient's sleep will feed all-important quantitative data back to physicians. A state of absence or significant alterations in activity level can alert carers and, possibly, emergency personnel, to potential emergency situations. For example, if a patient is detected to have left their bed and not returned for some time, this could indicate an accident or other incident requiring human intervention.

4) *Falls detector*: Falls are one of the greatest hazards for seniors, and rank highly on numerous survey results of biggest fears amongst this group. Thus, Mihailidis's ceiling sensor (a ceiling sensor, about the size of the average domestic smoke detector, which can detect when a patient has fallen), could offer real peace of mind, as well as vital assistance in lowering mortality rates from falls. The unit is designed to avoid error by establishing a verbal dialogue between the patient and the system, in order to ascertain whether a fall has occurred, before issuing a response call via wireless communication with a central control unit. Advanced sensing and computer vision also help the unit to identify the posture of the patient, and thus assess what is a fall and what isn't.

The current norm is the use of wearable devices featuring push buttons to be pressed in the event of a fall. These are common practice in retirement homes, as well as in some private dwellings. However, this method often fails, either because of the severity of injury sustained



in the fall, the level of cognitive impairment of the patient, or even the patient worrying about being a bother.

5) *Emergency alarm*: An emergency alarm is normally a device which contains a button that is pressed when a user is in a dangerous or emergency situation and requires immediate help. When a button is pressed, the device automatically sends an emergency message to a designated person or organisations such as family, doctors, police etc. The device can be programmed to assign a different button to each contact, for example button A for ambulance. The emergency alarm is also equipped with a location sensing sensor such as Global Positioning System (GPS) allowing location information to be sent with the emergency message resulting in quick response to the incident.

6) *Automatic lighting system*: The automatic lighting system allows any lights within the smart home to be switched on and off automatically when a person is in the area promoting a safer environment. The system uses motion sensor to detect the movement of a person to provide automatic illumination. Moreover, to save the energy, the system also equipped with photocell sensor allowing the system to operate only at night or in a dark environment. The automatic light system can be used in any rooms e.g. bedroom, living room, toilets, etc. or at the stairways. An example use of the system is when a person walks downstairs during the night, the system can illuminate the stairways increasing visibility, promoting safety environment.

7) *Video monitoring system*: The video monitoring system usually composes of video camera and a computer system. It is used to monitor people within the smart home. Video cameras are installed in any places that need monitoring. Example locations are such as living room, kitchen, hallways and etc. The video cameras record visual data which is interpreted into useful information for monitoring purpose later. Video monitoring system is used for security and safety purpose as it can powerfully detect human activity and behaviour, resulting in a prompt response in case of emergency and unusual activity i.e. falls and other accidents.

8) *Activity monitoring system*: An activity monitoring system is used to monitor activities of daily living such as walking, standing, cooking, etc. of a person and allows unusual activity, i.e. fall, to be detected for a faster response. The activity monitoring system is composed of a wrist watch which is equipped with various sensors such as accelerometer, radio frequency identification etc., used for activity detection. The sensor data is sent wirelessly and stored in a computer system allowing authorised people such as family and healthcare professionals



to monitor the activity of a user anytime anywhere. When abnormal activity is detected that information is sent to any authorised persons to ensure a user receives help as quick as possible.

There are also some concerns, -between engineers, carers, clients, family members - about the smart homes, especially the video monitoring got a big thumbs-down from survey participants. The threat of invasion of privacy is a very real one where video surveillance is concerned, and we've seen this negative reaction many times over the last few decades as CCTV surveillance has grown in the outside world. Apply this fear to our private space, and we balk.

Despite a generally positive response regarding technology for smart homes, researchers did note a lot of voices of dissent. Beyond video monitoring, many saw sleep monitoring and activity monitoring as being just as invasive, though – unlike video monitoring – there is a sense that this perception can be changed over time. It's hard to imagine a time when people would be happy to be monitored by cameras, under any circumstance, even where it is for their own protection.

Many European and worldwide projects, studies, and surveys shows that smart home technologies seem to be in favour in elderly care. Although now people may feel uncertainty about adoption of these new technologies, it is believed that by giving them real experiences of smart home devices, their usefulness and effectiveness should be more appreciated.