Research at Arup

Ambient Assisted Living

ARUP
**Arup Foresight + Research + Innovation**

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**Contacts**

**Chris Luebkeman**  
Arup Fellow and Global Director, Foresight + Research + Innovation  
chris.luebkeman@arup.com

**Marta Fernandez**  
Associate Director, Foresight + Research + Innovation  
marta.fernandez@arup.com

**Francesca Birks**  
Americas Lead, Foresight + Research + Innovation  
francesca.birks@arup.com

**Pam Turpin**  
Researcher, Foresight + Research + Innovation  
pam.turpin@arup.com

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Introduction

“The most elder-rich period of human history is upon us. How we regard and make use of this windfall of elders will define the world in which we live.”

If a need exists, mankind has an outstanding ability to invent a solution. The first vision aid was invented around 1000 AD, called a reading stone. It was a glass sphere that was laid on top of writing to magnify the letters. In 1808, Pellegrino Turri of Italy built the first typewriter to help his blind friend Countess Carolina Fantoni da Fivizzono write legibly. Alexander Graham Bell’s patent for the telephone in 1876 was a by-product of his studies with the hearing impaired. In more recent times, Gregg Vanderheiden, a professor at the University of Wisconsin-Madison developed the first communication device for people who cannot speak, and today continues to work to make the World Wide Web more accessible for people with disabilities. Pioneers such as Bill Gates and Paul Allen at Microsoft, as well as Steve Jobs and Steve Wozniak at Apple have also committed to making their technologies accessible to the widest audience possible.

The advancement of information and communication technology has started to allow health and care services to be delivered remotely, enabling vulnerable people to be supported in their own homes rather than in hospitals or residential facilities. Assistive technology is a rigorous multi-disciplinary field that brings together academic institutions, engineers, scientists, doctors and the public from around the world to share knowledge and improve the lives of people living with chronic conditions and disabilities.
This report highlights key challenges and opportunities for improving the wellbeing and quality of life of older people and those living with disabilities.

Below are key considerations for research and innovation that could be added to the agendas of urban and environmental planners, designers and health and social care researchers.

1. What is the impact of the built environment on the mental health of older people?

2. Do behavioural change programmes increase the use of technology in health and social care?

3. How can smart city planners ensure the development of liveable communities?

4. What are the optimum designs for transport systems for older people and those with disabilities?

5. How can we design cities to favour mixed communities?

6. What are the most effective interventions for increasing older urban dwellers’ contact with nature and how does this affect wellbeing?

7. How could street lighting be improved to optimise vision in older people and those with visual challenges?

8. What type of accessible walkways would help increase physical exercise and the social integration of older people?

9. Could autonomous vehicles solve transport difficulties experienced by older people?
Impact of an ageing global population

“No man loves life like him that’s growing old.”
—SOPHOCLES, “ACRISIUS”

One of humanity’s greatest achievements is increased longevity. People live longer because of improved sanitation, nutrition, medical advances, healthcare, education and economic wellbeing. A population is classified as ageing when older people become a proportionately larger share of the total population. Global ageing, driven by falling fertility rates and remarkable increases in life expectancy, is pervasive and unprecedented in human history.

According to United Nations forecasts, individuals aged 60 years and over are expected to increase from 688 million in 2006 to 2 billion (22 per cent of the world’s population) by 2050. For the first time, there will be more older people than children under 15 years.¹

Different countries are at very different stages of the process and the pace of this change differs greatly. For instance, Japan has seen very rapid ageing and has had to respond quickly to this phenomenon, whilst the population of countries such as Australia are ageing much more gradually.² Many developing countries are ageing rapidly.

Many facets of human life will be affected by population ageing including work, housing, transport, leisure, health and relationships. The best formula for success in an ageing world is for governments and policy makers to become aware of both the challenges and opportunities resulting from this longevity phenomenon.

Ageing should not be viewed as a negative process. In 2006, a global ageing survey covering 21 countries and approximately 21,000 persons aged 40 years and over found that individuals generally felt good as they aged. The survey also showed that older generations are not simply passive recipients of increasing amounts of care; they continue to provide important support within the family, the community and the workplace.

Country perspectives

Within developed countries, care for older individuals varies widely. The general trend within Europe, USA and Australia is to support the autonomy and independence of older people, enabling them to remain integrated in community life for as long as possible. In Sweden, local authorities ensure that a large proportion of older people receive home help services, good access to assistive devices and short-term care.³ Several countries and regions, including France, Germany, China, many states in the United States and Ontario, Canada, have made legal provisions for
adult children to financially support their parents. However, in many regions of the world, young adults need to migrate to cities for job opportunities, leaving older adults behind without family members living nearby. In Middle Eastern and Asian countries, the traditional cultural belief of filial piety that places an expectation upon adult children to care for their parents as they age has been steadily declining. In China, adult children feel less obligated to care for their parents if this conflicts with the demands of their job, instead adopting more practical approaches to meeting the criteria of a new law that requires them to visit and care for their ageing parents.8, 9

Because there is an absence of home-based care services, private institutional care often forms the only type of long term care service available.10

Currently, China has enough care home places for only 1.6 per cent of residents over the age of 60, and many of the staff employed are unskilled or have little training. More positively, the UK’s NHS and commercial sector is starting to collaborate with China to share expertise in providing high quality care for older people.11

Rise of chronic disease and disabilities

Improvements in life expectancy have led to a shift in the leading causes of death and disease. At the beginning of the 20th century, the major threats to life were infectious and acute diseases. Today, one of the major epidemiologic trends is the rise of disabilities due to chronic and degenerate diseases such as cardiovascular disease, diabetes, cancer, vision and hearing loss, and dementia. These diseases affect populations across the world regardless of income level. According to the World Health Survey more than a billion people are estimated to live with some form of disability (about 15 per cent of the world’s population).12

By 2050, nearly four in five people aged 60 or over will live in the developing world. In many countries, the oldest old (people aged 85 or older) are now the fastest growing part of the total population.
In many countries, older residents have higher levels of education and better financial resources than those of previous generations. With greater purchasing power, older people want to remain fit, active, and self-reliant.

Health and social care sectors are not well-equipped for modern needs. In the developed world, hospital-centric systems still dominate with frequently disjointed services often locked in provider-led silos, whilst in many countries in the developing world, health and social care services remain poor or non-existent.

For people with chronic conditions and/or disabilities, the ability to participate in society depends on their needs being actively addressed. Without such support, individuals can become dependent on family members who may have to give up paid employment to care for them. In many cases this has resulted in both parties having a poorer quality of life due to reduced income and social exclusion. For example, in the UK, a 2011 survey revealed that 4 in 10 people were in debt as a result of caring, and 1 in 2 had been adversely affected by the stress of financial strain related to caring.

Emerging technologies have the potential to facilitate better access and to reduce the costs associated with health and social care.
Assistive technologies

“That it will ever come into general use notwithstanding its value, I am extremely doubtful; because its beneficial application requires much time and gives a good bit of trouble both to the patient and the practitioner.”

—LONDON TIMES IN 1834, DESCRIBING THE STETHOSCOPE

In recent decades, information and communications technology has become ubiquitous throughout society. The advancement of sensor technology, and the Internet of Things has created new ways of delivering health and social care services. Along with these developments, new terms have been coined such as assistive technology, telemedicine, telecare, telehealth, e-health and m-health. While each covers a different subject area, there are considerable overlaps.

Assistive technologies embrace a wide variety of devices including “no-tech” solutions such as Velcro to allow easy fastening of clothing, “low-tech” items such as a walking cane or stair lift, and “high-tech” devices in the home such as sensors that monitor falls, fire or flooding, as well as “telecare” and “telehealth” care packages.

These systems can be supportive, preventive and responsive and can be classified according to their role. Assistive technology can also help caregivers. Instead of a husband having to read a letter to his wife because she has severe sight loss, she could use a magnifier or scan-and-speak software. A family member that lives miles from their loved one can keep in touch through video calls or monitor their movements around the home using sensor software through the Internet.
**Supportive technologies** help individuals perform tasks they may find difficult
- Medication reminder unit
- Stair lift
- Hearing aid
- Magnifier

**Responsive technologies** help individuals manage risks and raise alarms
- Pendant alarm
- Gas detector

**Preventative technologies** help to prevent dangerous situations and raise alarms
- Fall predictors
- Monitors for assessing physiological symptoms
- Room occupancy monitors

Assistive technologies can be supportive, preventive, or responsive and can be classified according to their role.\(^\text{18}\)

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**Telemedicine**

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.
Telecare

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. These can be classified into four generations of telecare (based on an evolution of the traditional “social alarm” model).

<table>
<thead>
<tr>
<th>Generation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>First generation</td>
<td>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</td>
</tr>
<tr>
<td>Second generation</td>
<td>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</td>
</tr>
<tr>
<td>Third generation</td>
<td>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</td>
</tr>
<tr>
<td>Fourth generation</td>
<td>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.</td>
</tr>
</tbody>
</table>

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.
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*.21

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.

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**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 (for example: battery replacement)

Adapted from Keer B et al (2010) Telecare and Dementia, DSDC: Stirling

Telecare is most effective if used as part of a package of support that is accepted by the individual and their formal and informal caregivers.

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**Telehealth**

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In the UK, driven by initiatives such as the Department of Health’s Whole System Demonstrator Programme, the 3 MillionLives campaign and the Concordat between the Department and the telecare and telehealth industry, the use of telehealth has been accelerating, putting the country at the forefront of advancements in telehealth care efforts across Europe.

Challenges to widespread adoption of telehealth and telecare

A key difficulty regarding the widespread adoption of telehealth 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 outcomes23 and users experiencing increased satisfaction with health and social care services.24, 25 Nevertheless, a number of studies have reported unsuccessful implementation and adoption within routine healthcare services. Recruitment difficulties have also be an issue for evaluation studies. Reasons

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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 advancing the health of individuals and their communities.
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.

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.

Telehealth adoption by health and social care professionals remains a change management issue rather than a technology usability issue.
**Telepresence**

Telepresence is a sophisticated form of robotic remote control. The remotely controlled robot or “telechir” and the human operator can be hundreds of miles apart. Control and feedback is achieved through wireless links, or the Internet. The development of service robots to assist older people or those with disabilities in activities of daily living (ADL) or to improve their quality of life in a home environment is an important research topic. It is believed that such technology will reduce the strain on informal and formal caregivers and minimise delay transfers to residential care.

In Japan, which has the world’s oldest population, the Prime Minister has allocated £14.3 m in the 2013 budget to develop robots to help with care.

**mHealth (mobile health)**

Patient-centric care or “care anywhere” is becoming a reality. Mobile healthcare (mHealth) is “the biggest technology breakthrough of our time”, particularly in remote communities and/or countries where there is a very uneven distribution of medical resources. The growing interest
in mHealth 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.²⁹

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 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.³⁰

**Health and social care mobile apps**

These applications are accessible to individuals both at home and on-the-go if they are able to connect to the Internet. In 2013 the number of health apps available to purchase or download for free was reported to be approximately 97,000.³¹ The tools ranged from helping consumers make healthier lifestyle choices to assisting patients with their chronic conditions (for example sending glucose readings to their primary care practitioner). Other
mobile apps combine mHealth with electronic medical records, thereby allowing doctors and care professionals working in the community to keep accurate and easily accessibly records. Research has indicated that by 2017, more that 3.4 billion people will have smartphones or tablets with access to mobile health apps, and 50 per cent of them will have downloaded health apps.\textsuperscript{32}

**Online health and wellbeing 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

The term ‘eHealth’ was first used by industry leaders and marketing professionals to characterise everything related to computers and medicine. Today the term is synonymous with the transfer of health resources and health care by electronic means.

### 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.33

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**eHealth encompasses three main areas:**

- The delivery of health information, for health professionals and health consumers, through the internet and telecommunications.

- Using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers.

- The use of e-commerce and e-business practices in health systems management.

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. For example, Facebook, which began with 5 million users in 2005, today has 1.23 billion active monthly users. Twitter has also shown tremendous growth from its launch in 2006 to 241 million monthly users globally in December 2013.

The number of older people using the Internet is increasing. For many, the benefits of using the Internet include not only the ability 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.

“Ever since I found out I had diabetes, I’ve posted monthly on Facebook about my struggles managing my blood sugar and energy level, and lots of people — some I don’t even know — have swapped healthy recipes, sent me tips on where to buy test strips, and even recommended doctors. Some even had links to YouTube videos.”

— Quote from Health Research Institute (2012)
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.

Research has shown less than a third (29 per cent) of people aged over 75 have used the Internet. The United States fairs better with 53 per cent of people over 65 years and 34 per cent of those over 77 years using the Internet whilst in Europe as a whole, two thirds of people aged 65 to 74 years are not Internet users. 38
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.

Governments across Asia 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.
CASE STUDY: PENSIONER RESCUED FROM FIRE BY CENTRA PULSE

A fast-thinking telecare operator saved an 83 year-old woman’s life. Mrs. Puffett was trapped in her Cambridgeshire home as a fire ripped through it. She was saved by a Centra Plus operator, after pressing her personal pendant, which links to an alarm unit. The unit allows operators to speak to the resident via a loud speaker and listen for any movement or sounds within the home. The operator called the Fire Service giving details about the property and important information about Mrs. Puffett held on a secure system at Centra Plus, and then rang her son to inform him. With the fire crews safely en route she constantly reassured Mrs. Puffett and gave life-saving advice including how to lay low to avoid inhaling smoke.

http://3millionlives.co.uk/about-telehealth-and-telecare#what_is_telecare?

CASE STUDY: THE RAFT NETWORK

The RAFT network provides telemedicine in African Francophone countries. The main challenge addressed is the de-isolation of care professionals working in remote areas of developing countries. Continuing education of healthcare professionals is a key element for the quality and efficiency of a health system. The core activity of RAFT is the webcasting of interactive courses targeted to physicians and other care professionals. Courses are webcast every week, freely available, and are followed by hundreds of professionals who can interact directly with the teacher.

User Profile: Passive Infrared Sensors aid elderly with Alzheimer’s disease

“Mr. Ramsey is 80 years old and has Alzheimer’s disease. He regularly leaves his home at night to try to go to work, and his family is increasingly concerned for his safety. A PIR (Passive Infrared sensor) linked to a light box was used to help Mr. Ramsey. This was fitted to the inside of his external door, and when he approached the door, the beam was broken, illuminating a message on the box reading ‘Don’t go out as it is night time’. The light box was programmed to come on during the night. The exact wording of the message was changed regularly, to make sure that Mr. Ramsey did not get so used to it that he stopped noticing it. If this intervention had not been successful, other techniques could have been used, using smartphones with GPS or other connected objects.”


User Profile: Telemonitoring improves quality of life: New Zealand

“Ray Butler, who has the lung disease Asbestosis, manages his condition with the assistance of a telemonitor in his home. The telehealth monitor enables patients to take their own vital sign measurements, such as blood pressure. These measurements are then assessed remotely by nurses, enabling medical teams to detect changes early, before the person develops a serious issue that needs hospital treatment. Additionally, the monitors reinforce the client’s ability to self-manage their condition. Initially, Ray was uncertain about the technology. ‘When I started, I hadn’t had anything to do with computers, but after a bit of coaching, I soon mastered it. [My] condition hasn’t changed...but now with help, I feel I’ve got it under control and it’s not so scary. I feel I can stay out of hospital and feel quite confident about the future.’”

CASE STUDY: WELLDOC INC — MOBILE COACHING AND ONLINE DECISION SUPPORT FOR DIABETES

WellDoc Inc., a healthcare behavioural science and technology company, has created a system of instant feedback and coaching, driven by clinical evidence-based guidelines and behaviour science. A 2009/2010 US trial of the WellDoc system sought to reduce blood glucose levels in 163 patients suffering from diabetes. Each participant received a glucose meter and supplies along with a mobile phone application and access to a web portal. Patients entered blood glucose levels and other self-care data into their phones and received real-time responses from a virtual patient coach, providing assistance on managing the condition as well as tips on diet, exercise and other aspects of their lifestyle. The results showed a mean decline in hemoglobin (A1c) counts by 1.9% in the intervention group. A clinically significant change was seen regardless of whether patients began the trial with a high or low count.

http://www.welldoc.com

CASE STUDY: DIGITAL INCLUSIONS KIT IN HEALTH, ARGENTINA

Patients in marginalised areas in both urban and rural Argentina lack access to specialised medical centres, which are often the only sites where vital diagnostic tools are available. Researchers at the University of Buenos Aires are creating a Digital Inclusion Kit in Health and Higher Education (DIKHAE), which will allow smartphones to wirelessly connect to diagnostic tools like electrocardiograms, enabling sophisticated diagnoses to be conducted remotely. The test results can be stored on the smartphone until it is in range of a cellular signal, and can then be uploaded to a patient records system.

CASE STUDY: “GROUPLE” HELPS CAREGIVERS THROUGH SHARED INFORMATION, UK

“Grouple” is a UK-based online tool that is being piloted for families and friends caring for someone with dementia. It is a private and secure network for caregivers to share their concerns and experiences. When a relative visits the person with dementia, they add the visit as an event to the shared timeline, together with any relevant notes. Tailored reports can also be printed out and given to the relevant physician or social worker. Grouple is at the early stages of development; the impact on users and the person they care for is still to be fully evaluated.


CASE STUDY: ONLINE CAREGIVER COACHING, USA

In 2006, the Alzheimer’s Association of Greater Cincinnati launched a website that provides online caregiver coaching to family members of individuals diagnosed with Alzheimer’s disease or other related conditions. Offered free of charge to family caregivers in the Cincinnati area, the programme provides a personal coach who offers individualised education, support, guidance and care planning assistance to caregivers of people with dementia. The online availability of the coach, through a secured website ensures that questions and needs are addressed on the caregiver’s time schedule, with the coach usually responding within 24 hours. Coaching is performed by a master’s level social worker with experience in dementia care and family issues.

http://www.alz.org/cincinnati/in_my_community_12317.asp
CASE STUDY: VIRTUAL MEDICAL KIOSK, BANGALORE, INDIA

EHealth Access, a company focused on developing the healthcare eco-system through advanced telemedicine technology, launched the Virtual Medical Kiosk in 2012 enabling patient-doctor consultation in a secure environment. Individuals can communicate through phone, webcam, video conferencing, messaging or chat. The kiosk is embedded with a touch screen system, audio-video capabilities, diagnostic equipment, a scanner and medical management software capable of recording personal health data. It facilitates on-demand, real-time consultations with medical professionals at any time of the day.


CASE STUDY: NEURORACER GAME ENHANCES COGNITIVE CONTROL IN OLDER ADULTS, USA

Researchers at the University of California trained 60- to 85-year-old participants to play a game called Neuro Racer. Multitasking performance was assessed with the custom-designed, three-dimensional video game. By playing an adaptive version of NeuroRacer in multitasking training mode, older adults reduced multitasking costs compared to both an active control group and a no-contact control group. After four weeks of practice, the participants were better than untrained 20-year-olds at multitasking, and their short-term memory and attention had vastly improved.

http://www.nature.com/nature/journal/v501/n7465/full/nature12486.html
CASE STUDY: ROBOTS AS HEALTHCARE COMPANIONS, JAPAN

Japan has a monopoly on healthcare robots due to its significantly ageing population. One of the most popular and accessible care robots available is Paro. Paro is a therapeutic robot designed for elderly with Alzheimer's disease or dementia. Modelled like a seal, it has pet-like reactions to being stroked and touched and has been shown to soothe and calm people in care and to encourage socialisation.

http://www.bbc.co.uk/news/technology-24949081

CASE STUDY: INTERACTIVE VIDEO DANCE GAMES FOR HEALTHY OLDER ADULTS, USA

Healthy older people (mean age of 80 years) were recruited from three senior living communities and offered three months of training and supervision using a video dance game designed for older people. Before and after the programme, data was collected on vital signs, physical function and self-reported quality of life. Feedback was obtained during and after training. Of the 36 people who entered, 25 completed the study. Participants who completed the program showed gains in narrow walk time, self-reported balance, confidence and mental health.

Human-centred design practices

“The multidisciplinary field of human factors aims to understand the properties of human capability to inform the design, development and implementation of systems and services. It uses theories, principles and tools from various domains including industrial design, engineering, psychology and anthropology.”

— Charness et al: 2010

The change in the focus on care is encouraging health providers worldwide to advocate that the delivery of health care, particularly chronic conditions, should be within a person’s own home rather than medical settings. This transition has raised a number of issues that to date have not received enough attention. For example, very few homes have been designed for the effective delivery of healthcare. The environment can support or diminish the quality of care a person receives. Although every situation is unique, a successful outcome is dependent on the people involved, or the human factors.

By developing this approach in the delivery of healthcare in the home, a number of telehealth-related processes such as equipment design, task design, environmental design and user training can be addressed. Maximising user experience must be a key consideration. The interaction between the people involved, health technologies, and the home environment should be considered. This interaction is called person-environment fit.

Successful fit is dependent on the degree to which individual physical, sensory, cognitive and emotional capabilities match the corresponding demands imposed by the technology being used. When using computers or smart phones, people are expected to have the physical and cognitive capability to connect to the Internet, click, double-click, tap, flick, scroll, etc.

For example, the demands of making a video conferencing call with a physician would require the ability of a patient to use the hardware (computer, screen), manage any audible equipment (headphones, speakers,
microphone) as well as to understand the software (how to receive and transmit information). In addition, poor lighting, furniture positioning, or unreliable Internet connectivity may negatively affect video or audio quality. Such demands on user capabilities include vision, hearing, cognition and psychomotor ability. If demands are too great, the person may fail the task or complete it in an inefficient manner. Levels of personal satisfaction and wellbeing may also be affected. In such cases, efforts to reduce the demands on the individual should be considered.

**Universal design**

History has shown that the needs of older people and individuals living with disabilities have not been sufficiently considered by planners and governments. Inaccessible spaces, poor-quality urban spaces and unsuitable architectural design features within buildings and facilities result in an inability for many to fully participate in society.

Universal design has two important benefits. When applied to the design of public spaces, transport, buildings as well as products, it has been shown to enable people to maintain independent lifestyles and increase social inclusion.

Could the technology itself be modified to increase the user’s capabilities? Could task execution be simplified? Does the layout of the room need adjusting? Can connectivity be improved? Or could training to boost an individual’s technological skills be the most appropriate solution?
In 1997, the Seven Principles of Universal Design were developed by a working group of architects, engineers and environmental and product design researchers in the North Carolina State University, USA. They are meant to guide the planning design and construction processes to support quality of life.

<table>
<thead>
<tr>
<th></th>
<th>Principle</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Equitable use</td>
<td>The design is useful and marketable to people with diverse abilities</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility in use</td>
<td>The design accommodates a wide range of individual preferences and abilities</td>
</tr>
<tr>
<td>3</td>
<td>Simple and intuitive use</td>
<td>Use of the product or service is easy to understand, regardless of the user’s experience, knowledge, language skills and current concentration level.</td>
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<tr>
<td>4</td>
<td>Perceptible information</td>
<td>The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities</td>
</tr>
<tr>
<td>5</td>
<td>Tolerance for error</td>
<td>The design minimises hazards and the adverse consequences of accidental or unintended actions.</td>
</tr>
<tr>
<td>6</td>
<td>Low physical effort</td>
<td>The design can be used efficiently and comfortably and with a minimum of fatigue.</td>
</tr>
<tr>
<td>7</td>
<td>Size and space for approach and use</td>
<td>Appropriate size and space is provided for approach, reach, manipulation and use regardless of user’s body size, posture and mobility.</td>
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Engaging the elderly in planning and decision making

A fundamental shift in the way society views older people is starting to occur with a move away from dependency and decline, towards independence and wellbeing. In order to fully prepare for an ageing society, it is critical that planners and policy makers engage with older people to enable them to have choice and control in their lives.

A central component to older people’s wellbeing is interdependence; the ability for them to contribute to the life of their community, where that contribution is valued and recognised. Engagement can be at various levels from being consulted about a plan, product or service to high-level involvement in decision making and agenda setting.
Successful engagement is more likely to occur if careful consideration and planning is given to overcome potential barriers to engagement:

- Information in accessible formats and languages
- Venue suitable for people with disabilities (e.g. wheelchair access, induction loop system for hearing impaired)
- Time and length of meetings
- Consideration of possible transport issues
- Genuine process in which participants are informed about the impact of their contribution.

**Housing for an ageing population**

Most adults would prefer to age in place, remaining in their home of choice as long as possible. We are all destined to grow older, but as we do, will the community we live in be able to support us? People tend not to consider liveability until they are affected by the challenges of ageing and/or disability, by which time it may prove difficult for people to make changes such as home modifications, moving to a more appropriate setting, or influencing the way the community can support them.
Liveable communities

In the past, planners have tended to focus on topics such as the economic growth, sprawl or allocation of scarce resources within a community. However, with the rise in the number of older citizens, consideration to how the community can make a positive influence to individual wellbeing (such as how the physical and social environments can promote independence and encourage engagement), need to be added to the smart city agenda. This would facilitate the development of “liveable communities”.

A study by the MacArthur Foundation made the connection between a liveable community and community engagement to enable successful ageing, which describes “the ability to maintain three key behaviours or characteristics: low risk of disease and disease-related disability; high mental and physical function; and active engagement with life”.

To promote liveability, homes need to be affordable to allow individuals to remain in their communities where they have long term attachments. Good home design promoting accessibility and ease of use will enhance wellbeing. In addition, community services such as transportation and mobility options play a prominent role.
As people age, driving may become difficult or even impossible due to physical or cognitive decline. Options such as easy walking routes and efficient public transport systems will all add to a person's sense of safety, independence and quality of life.

Another solution being explored by the car industry is the development of autonomous vehicles for those who do not wish to physically drive themselves. This type of driverless vehicle is capable of sensing the environment and navigating with minimal or no human input.

**Age-friendly cities**

A global network of age-friendly cities was launched by the World Health Organisation in 2010. The aim of the network is to help cities create urban environments that allow all citizens to remain active and healthy participants in society.

The Council of Europe also has a disability action plan for 2006-2015, which recommends that EU member states should integrate the principles of universal design into development in the built environment, transport, product research and information technology.
Dementia-friendly communities

Dementia is a truly global issue. There are an estimated 44 million people worldwide living with dementia, with numbers predicted to rise to 135 million by 2050.47 62 per cent of people with dementia live in developing countries, but by 2050 this is projected to rise to 71 per cent.48

With 7.7 million new cases of dementia each year, improving the quality of life for these individuals and their caregivers is high on most countries’ agendas. Different care solutions are being considered. One school of thought is to develop self-contained “dementia villages” where people with the condition can live safely.

While it could be argued that such facilities are no more than beautifully designed prisons and only serve to socially exclude such individuals from society, the concept of “dementia-friendly communities” is starting to emerge. A different viewpoint is to accept that dementia is a disability and enable people living with this condition to remain connected with their community.

A dementia-friendly community is a city, town or village where people with dementia are understood, respected, supported, and confident that they can contribute to community life. Each community will have its own diverse populations and the focus must be on
understanding the demographic variation and the needs of people with dementia and their caregivers. A key training area is on increasing public understanding of dementia, challenging the stigmas and dispelling misinformation and myths about the condition.

Living environments for older people

Older people are a heterogeneous group; different people need different solutions for their living space. Some people wish to live independently, and others prefer interdependency, accessing assistance when needed from family and informal caregivers. Others require regular support for their daily living needs, whilst the frailest in society may need 24 hour care to maintain a desired quality of life.

Staying in your own home

Many people choose to continue to live in their own home using modifications to increase their independence and lower the risk of accidents. Some examples of low-cost home modifications include: additional railings, grab
bars, non-slip flooring, increased lighting, visual aids on kitchen appliances to facilitate easier use and the removal of trip hazards such as rugs and clutter. More extensive modification options include retrofitting the installation of ramps for accessible entry and exit, adding stair-lifts and walk-in showers and incorporating universal design features to make everything in the home accessible to everyone regardless of age and ability.

**Multi-generational housing**

Historically, households containing several generations have been common particularly in Asian communities. This form of community housing is becoming more popular in the developed world. Evidence suggests that significant factors such as higher unemployment, the rising costs of living, caring responsibilities, and greater multiculturalism are responsible for this trend. In many parts of the world, for example, southern Europe and East Asia, more than 50 per cent of households comprise three or more generations, but a growing movement for this type of housing arrangement is now occurring in countries such as the United States, Australia and New Zealand. Design options vary: generations can all live under one roof with
little or no autonomy or privacy. Other solutions include one building with two kitchenettes and more privacy, or a context where family resources are pooled and two dwellings are built within a footprint that would typically be used for one larger-scale house. This is known as “gentle density”.

Co-operative living and co-housing

In a co-housing development, residents live as part of a community. Key values include neighbourliness, mutual support, collaboration and sharing of resources. Physically, the facility is designed to increase social interaction.

Individual homes are clustered around a common house or room, facilitating shared meals and community events. Co-housing originated in Denmark in the 1960s and around 5 per cent of Danish people live in co-housing arrangements. Co-housing groups have since been set up in other countries, such as the Netherlands, USA, Canada, and Australia.

There are two co-housing models that exist; the intergenerational or family-based model and senior co-housing, for age-peer groups over the age of fifty.50
In the Netherlands, the concept of co-housing is central to government policy, on the grounds that it sustains health and wellbeing, promotes independence, reduces social isolation and decreases demands on health and social care services.

A recent development in the Netherlands is retrofit co-housing, where housing associations assist the older tenants of existing apartment blocks to form a mutually supportive and sociable living group without moving. A flat is kept untenanted to act as the common house. In the UK, a cohousing project including only older women is due to be completed by 2016.

Eco-friendly living

Eco-friendly housing (also known as green building) combines energy efficiency and environmental sustainability as key considerations. Energy-saving initiatives are an important factor for older people who often need to keep their houses warmer due to frailty or poor health. Homes are often built to take advantage of wind turbines, efficient lighting and insulation, water conservation methods, recycling and waste management. Building materials and techniques are also environmentally friendly.
Retirement villages

Retirement villages are a relatively new type of housing for older people, but are growing in popularity in the western world because they allow a combination of independence and security. These larger developments, usually 100 or more properties, offer a variety of housing types such as independent flats or bungalows together with an extended range of social, sport and leisure facilities, retail outlets, and health care and support services, as needed.

Housing with additional support

“Sheltered”, “warden-assisted” or “retirement” housing are terms that describe accommodation designed specifically for older people. They promote privacy and independence but with the reassurance of an alarm system to enable a resident to summon help in an emergency. Facilities are usually designed with doorways wide enough for wheelchairs or walking frames and have good levels of heating. Additional facilities include communal laundry, common rooms for social activities and shared gardens.

“Extra care housing”, “housing with care” and “assisted living residences” are terms used to describe
housing for older people who need assistance with daily activities, such as bathing, dressing, preparing meals and taking medication. They are for individuals who do not need 24 hour complex medical supervision and are often seen as an alternative to residential care (care homes).

“Close care housing” is a form of sheltered/retirement accommodation that is linked to or on the same site as a care home. They are particularly useful for couples where one partner is in need of a care home but they do not want to be separated. The frailer person lives within the care home and can access all the support they need whilst the fitter partner can spend as much time as they wish with their partner but live in an independent accommodation on the grounds.

This type of housing may also appeal to someone with a deteriorating condition but who wants to stay independent for as long as possible. They could live in the self-contained accommodation and become familiar with the care home and staff so that if they do become in need of 24 hour care, the transition to the main home can be less stressful.

“Care homes” have changed significantly since the 1960s when many were missing basic amenities such as individual bathrooms or central heating. More thought is
now given to better lighting and building design although better facilities for those with dementia are still required.

“Residential homes” are for people who need 24-hour support for personal care (getting in and out of bed, dressing, washing and going to the toilet). Residents have a room, sometimes with their own en suite bathroom, and have access to shared facilities. All meals are provided and many offer some social activities.

“Nursing homes” are for people who need 24-hour care and daily tasks that are carried out by a qualified nurse. Nursing tasks include giving injections, peg feeding, dressings, pressure sore care etc. There is also a need for a qualified nurse to be on duty at all times.

Because of the emphasis on supporting people to live in their communities for as long as possible, the proportion of people entering care homes with challenging behaviours is increasing. Many residents are living with neurological disorders such as dementia and/or stroke, with large numbers requiring high support needs such as incontinence or severe mobility problems.

In the future, care homes are likely to become a final home for people in need of intensive levels of medical, psychological and physical care providing both palliative and end of life care to avoid transition to acute hospital facilities in their final days.
Smart and connected homes in the future

“Smart homes”, sometimes referred to as “assistive domotics” or “intelligent housing”, are residences that are equipped with sensors, wired and wireless networks and intelligent systems. The smart house concept has been developing since the early 1990s but the widespread deployment of such housing is still limited. One of the important application fields has been the safety and security of residents, where sensors not only protect against burglary but are also able to monitor behaviour and use that information to prevent accidents from happening.

Technology is also used to enable independent living by focusing on solutions to improve the health and wellbeing of residents. A wide variety of services are offered from medication adherence and reminders to behavioural pattern recognition. Services also focus on the wellbeing of an individual, ensuring heating and lighting levels are optimal and enabling video connections with friends, family and health and social care professionals.
CASE STUDY: MOBILITY FOR OLDER PEOPLE, JAPAN

Japan has one of the most rapidly growing ageing populations. A number of measures have been introduced to respond to this phenomenon, which implement the principles of universal design to allow older people to remain independent and health contributors to society. The Elderly Care Insurance System is a long-term care insurance that covers home care and enables older citizens to live in their own homes while receiving care. In 2000, a Public Transportation Accessibility Act was passed that obliged transportation businesses to make their facilities and equipment accessible. In 2005, a General Principles of Universal Design Policy was introduced, which stipulated that the concepts of universal design should be used in the development of buildings and public transport. Finally, in 2006, a Barrier-Free Act was introduced which further incorporated universal design into infrastructure and building design.

http://journal.aarpinternational.org/a/b/2010/06/Toward-Universal-Design--Improving-Mobility-for-Seniors-in-Japan

CASE STUDY: SENIOR CORPS, USA

Senior Corps is a network of programmes that tap the experience, skills, and talents of older citizens to meet community challenges. Through the organisation’s three programmes (Foster Grandparents, Senior Companions, and the Retired and Senior Volunteer programme), more than half-a-million Americans aged 55 and older assist local nonprofits, public agencies, and faith-based organisations in carrying out their missions. Taken together, these programmes engage more than two-million Americans of all ages and backgrounds in service each year. Senior Corps is part of the USA Freedom Corps, which is administered by the Corporation for National and Community Services.

www.seniorcorps.com
CASE STUDY: A VILLAGE DESIGNED FOR PEOPLE WITH DEMENTIA, HOLLAND

In the Netherlands, a radical idea is being tested: self-contained “villages” where people with dementia shop, cook, and live together – safely. In the small town of Weesp, Holland, a dementia-focused living centre called De Hogeweyk, or Dementia Village, serves as a model for the rest of the world. The secure compound contains apartments and buildings, closed to the outside world with gates and security fences. Inside, it is its own self-contained village, with amenities such as restaurants, cafes, a supermarket, gardens and a pedestrian boulevard.

http://www.goodnewsnetwork.org/civics/dutch-village-designed-just-for-people-with-dementia.html

CASE STUDY: ACTIVE LIFE FOR FRAIL ISOLATED ELDERS (ALFIE), TOWER HAMLETS, UK

The ALFIE project, run by Tower Hamlets Friends and Neighbours, arranges one-to-one accompanied trips to local parks, shops, museums and cafes in addition to home-based activities such as reflexology, crafts or seated exercise. Reminiscence activities have been implemented for people with dementia, through which they are able to share their life stories. A related project called the ALFIE club is being run in partnership with a range of other organisations including sheltered housing schemes, centres and other voluntary organisations. Events such as school choirs, singers, pampering sessions, a visit by a city farm with animals, a reminiscence session by a Bengali storyteller, teach parties and group seated exercise activities have taken place throughout the borough. Activities are chosen by each client according to their needs and wishes, and as a result participants describe feeling more connected and engaged with the community.
User profile: the Thomas family

“At the time they decided to live under a single roof, Tupper Thomas, 69, was living in a condo, and her daughter, Phaedra, 37 had recently divorced. When the mother proposed that they take up joint residence, her daughter was incredibly enthusiastic. The first floor of the residence has a separate door leading to Tupper’s quarters, with a spacious open kitchen and a living room that faces the tree-lined street. The second and third floors, home to Phaedra and her children, include a playroom, the communal washer-dryer and Phaedra’s childhood bunk bed. The mother bought the house. The daughter, who works part time, pays a monthly rent that includes her share of taxes and utilities. Household expenses are shared, and the daughter benefits from free child care. “And over time, she’ll take care of me,” Tupper said. “It’s a smart investment for both of us.’’"
**CASE STUDY: WESTBURY FIELDS, UK**

Westbury Fields is home to around 230 people with an age range from 55 to 102 years. On the site there is a 60-bed care-home which includes a specialist dementia unit and a short-term care service. Additionally, the village has 149 one-, two- and three-bedroom retirement apartments and a range of communal facilities, which offer the possibility of a positive lifestyle. Apartments are available to purchase, to rent at social housing levels, and to part rent/part purchase shared equity. This flexible model of tenure has ensured that Westbury Fields is available to older people from a wide socio-economic group. The renting of apartments at Westbury Fields is operated in conjunction with Bristol City Council who has the right of nomination for vacancies. This close working partnership has proven positive for all entities involved.

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**CASE STUDY: ECO-FRIENDLY LIVING, UK**

Railway Housing Association, working with Yuill Homes created 14 new eco-friendly homes: 10 two bedroom bungalows and four two bedroom apartments in Spennymoor, County Durham. The bungalows have front and rear gardens and all have photovoltaic roof tiles that capture the sun’s energy, providing electricity to the communal areas and helping to heat the water in the homes. The properties all have water collection systems and underground tanks that capture rainwater and effectively recycle it for use in washing machines and for toilets.

http://www.railwayha.co.uk/news-article.asp?newsid=43
Conclusion

“The problems of aging present an opportunity to rethink our social and personal lives in order to ensure the dignity and welfare of each individual.”

— DAISAKU IKEDA

Our world is now an ageing world. By 2050 there will be two billion people over 60 years of age, nearly a quarter of the world’s population. Increased longevity is, of course, a sign of progress, and we should celebrate this achievement. However, declining health in older age can lead to pressures on governments’ health and social care systems and a reduced quality of life for our older citizens.

It is essential to take a holistic view of this challenge and involve older people directly in the design of future health, social care and housing models that meet their needs.

Assistive technology is a rigorous multi-disciplinary field that brings together academic institutions, engineers, scientists, doctors and the public from around the world to share knowledge and advance this field thereby improving the lives of older people living with chronic conditions and disabilities.

As humans, we are all temporarily able bodied. If we live long enough, it is likely that each of us will benefit from some form of assistive technology. Affordable housing, devices and gadgets that are universally designed, and accessible to all, including the most disadvantaged communities, must become our mantra for a positive global vision of our ageing world.
References

References

28. US Health and Human Services Secretary, Kathleen Sebelius in her keynote address at the 2011 annual mHealth Summit in Washington, DC area.
35. McQuater, K(February 2014) Infographic: Facebook’s 10th Birthday – the rise of the social media giant accessed at http://www.thedrum.com/news/2014/02/03/facebook-10
42. Kochera A and Straight A (2005) Beyond 50.05: A Report to the Nation on Liveable Communities; AARP: Washington DC
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Author
Pam Turpin

Graphic Design
Mark Pearsall

Editor
Radha Mistry

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Katherine Prater

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Pam Turpin
Our world, is now an ageing world. By 2050 there will be two billion people over 60 years of age, nearly a quarter of the world's population. Increased longevity is a sign of progress, however, declining health in older age can lead to pressures on governments' health and social care systems and a reduced quality of life for our older citizens.

Assistive technology is a rigorous multi-disciplinary field that brings together academic institutions, engineers, scientists, doctors and the public from around the world to share knowledge and advance this field thereby improving the lives of people living with chronic conditions and disabilities.

The advancement of information and communication technologies has started to allow health and care services to be delivered remotely enabling vulnerable people to be supported in their own homes rather than be cared for in hospitals or residential facilities.

It is essential to take a holistic view of this challenge and involve older people directly in the design of future health, social care and housing models that meet their needs.