

The ageing population

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The UK Focus for Biomedical Engineering, a group hosted by The Royal Academy of Engineering, provides a forum through which the principal organisations concerned with biomedical engineering can discuss debate and jointly act upon important issues. The group regularly organise briefing seminars, produce policy papers and engage with the policy community.

Introduction

The continuing rise in the proportion of older people in the population presents serious challenges at a time of fixed or falling public expenditure. This increase in the numbers of older people is already putting considerable strain on health and social services, particularly for community services as government policy stipulates that care for older people should be delivered as close to their homes as possible (this is also the expressed wish of 90% of older people). Ageing of the population will lead to an increase in, disability, age-related illnesses, such as diabetes and dementia. The need to provide the greatest possible level of independence for people with dementia presents medical, social and financial pressures. Perhaps even more important, is the need to harness technology to support healthy ageing.

Engineering underpins many of the actions required to improve the quality of life of the elderly, including medical, social and infrastructure needs. As well as enabling advances in medical technology, engineers are helping to provide a clear vision for building homes and communities with the ageing society in mind. They have been actively working to improve transport infrastructure to enhance independence and socio-

economic activity in old age. Inclusive design approaches can contribute to an environment equally usable by all sections of the population. Advances in sensors and intelligent control systems/computers are allowing the development of remote care or Assisted Living allowing people with dementia or long term conditions to remain in their own homes. There is already available a wide range of assistive technologies which can be considered in three groups according to needs:

Level 1: Empowerment

Where health is monitored using technologies to keep the individual ageing at the healthiest rate, eg. blood pressure monitors – this can be used at all stages of life to promote healthy lifestyles. These technologies are of benefit to all people and allow measurement and feedback of key measures such as body mass index, blood pressure, blood sugar etc. Rapid developments of mobile phone technology are making it simple to transmit these data to personal databases or health professionals. This has the potential to be a major force for driving a healthy ageing agenda.

Level 2: Support

Where appropriate technologies can restore almost complete independence. These developments cover simple devices such as

spectacles, contact lenses and hearing aids through to sophisticated implants, dominated by the success of total joint replacements to maintain independent mobility.

Level 3: Dependency

Where an individual becomes dependent on a range of technologies allowing continued (assisted) living at home. These devices and systems are aimed at the rapidly growing need to maximise the independence at home of people with long term chronic conditions with an emphasis on those with cognitive impairments associated with dementia. This area presents the greatest technical challenge but also the greatest financial benefits by minimising the numbers of people requiring care accommodation. Technology has, therefore, considerable potential to manage many people's medical conditions in the community.

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The challenge

The UK's population is ageing rapidly; there are now more pensioners than under-16s. The fastest growing age group is those 80 years and over, who now constitute 4.5% of the UK population. These changes are leading to increased dependency of a large proportion of the population on the financial, social and medical support of the community.

Major illnesses affecting older people include diabetes, Parkinson's disease and dementia. Annually, approximately 112,000 people over 55 suffer a stroke, and many of these people live for many years with associated disabilities. Diseases such as osteoporosis, stroke and arthritis reduce the mobility of many people, increasing dependence on healthcare services and carers. Those over the age of 75 have a significantly greater risk of accidental death at home or on the street, as compared to the total population. Falls represent the most serious risk for all accidents amongst older people, with the majority of them occurring in the home, particularly on stairs. As a result of reduced mobility, lack of access to services and poorer health, many elderly people can become isolated from their communities, physically and socially.

Dementia is one of the main causes of disability in later life; in terms of Global Burden of Disease, it contributes 11.2% of all years lived with disability, higher than stroke, musculoskeletal disorders, heart disease or cancer. One in 14 people aged over 65 has a form of dementia, rising to one in six of those over 85. In the UK, there are currently around 700,000 people with dementia and this is estimated to rise to 1 million by 2020 and 1.7 million by 2050, an increase of over 150%. The total costs of caring for people with dementia in the UK have been estimated at £17 billion a year. Currently around two-thirds of people with dementia live in private households, with the majority of their

care provided by family supporters and primary and community care teams.

The availability and cost of care accommodation is of major concern placing the emphasis on using technology to maximise independence at home. A wide range of assistive technologies is available from a simple bathing aid through to sophisticated sensor systems providing assisted living. The cost-effectiveness of these interventions is impressive. A raised toilet seat costing £8.50 can obviate the need for a home care package costing £100 a day. While 30% to 50% of people over 65 fall each year, a walking frame costing £50 can prevent a fall and emergency admission to hospital. Assisted living technologies can reduce the need for residential care where a bed costs between £300 and £400 a week, and a nursing bed can cost up to £500 a week. Further, a US study has shown that preventative Assistive Technology can save up to £8,000 per person per year.

Engineering Solutions

The above examples illustrate the abilities and potential of technology to meet the challenge of ensuring maximum mobility, independence and safety for the elderly. Potentially, this support covers aspects of ageing from feedback to promote healthy ageing through to the use of advanced sensors allowing people with long term chronic conditions or cognitive problems associated with dementia to live independently in their own homes. These assistive technologies can be usefully grouped at three levels corresponding to the inevitable biological ageing process. At the first level – 'Empowerment' – a wide range of feedback devices are already available to promote healthy living and ageing. These currently include sophisticated weighing machines, easily used blood pressure monitors etc together with websites to allow estimation of 'biological age'. The future potential of this approach

is enormous, embracing the use of novel sensors (some within clothing) together with data transmission through a mobile phone.

At the next level, 'Supported', a range of technologies can be used to maintain almost complete independence in the presence of a number of impairments. The most frequently used device in this category is a pair of spectacles, but further well used examples are hearing aids and total joint replacements. Studies by National Institute for Clinical Excellence (NICE) have well demonstrated the cost effectiveness of total joint replacement and further research and development will lead to longer wearing replacements for a wider range of joints. Of particular importance at this level is the routine use of inclusive design of the built environment, home appliances etc. In many cases this may be as simple as ensuring the information displays are easily usable but there are significant challenges for the developers of largely 'technology push' IT systems.

At the third level – 'dependent' – are the group for whom technology can make the difference between living at home or in care. These people are predominantly those with dementia making the routine tasks of living very difficult. Assisted living solutions (smart homes) are still under rapid development but have reached the stage of use by large numbers of people. These systems, using advanced sensors and communication monitor activities such as time in bed, time between movements within the home etc. Fall and vital signs sensors may also be used. Live communication with a remote carer is also normally possible including the facility for live conversation and advice.

This is the area employing the largest amount of high technology and with the greatest potential for maintaining home living with the attendant social and financial benefits.

Category	Technology examples	Benefits
<i>Informing</i>	<p>"Smart" clothing, integrating sensors into fabrics</p> <p>Telemedicine, eg delivering medical advice, diagnosis, monitoring or even treatment via phones</p> <p>Monitoring devices, eg blood pressure and blood sugar sensors</p>	<p>Unobtrusive, easy to use technology</p> <p>Ability to adjust lifestyle factors such as diet and exercise appropriately</p> <p>Better healthcare at minimal cost</p>
<i>Supporting</i>	<p>Surgical/medical procedures, eg joint replacements</p> <p>Incontinence support, eg garments, catheters and surgical solutions</p> <p>Neuroprostheses, eg sensory devices for vision and hearing</p> <p>Interactive devices, eg GPS and mobile phone networks that provide accessibility to information in public areas</p>	<p>Inclusive design reduces stigma</p> <p>Individual has better accessibility to complex information</p> <p>Quality of life can be maintained to a reasonable extent</p>
<i>Assisting</i>	<p>Assistive devices, eg spectacles, hearing aids</p> <p>"Smart" homes, using surveillance systems, intelligent appliances, sensors and mobility aids.</p> <p>Rehabilitation methods, eg haptic devices that use virtual environments to enable individuals to regain a sense of touch</p>	<p>Allows individuals to remain in their homes for longer</p> <p>Technology can be tailored to the individual's needs</p> <p>Minimises dependence on family and carers</p>

Conclusions

Engineering has a key role in helping to deal with the challenges of an ageing population with a need to focus on a number of priorities. It is vitally important to ensure healthy ageing across all age ranges and that as many older people remain living in their own homes as is possible. The engineering contributions to this aim are as follows:

1. Inclusive design approaches to infrastructure, home environment and appliances is essential. This entails an understanding not only of physical limitations but also of cognitive aspects.
2. Matching of solutions and technologies. A wide variety of assistive technology is available, but there is considerable evidence that around 23% to 40% of the equipment supplied is never used. This commonly arises because of inadequate data on the environment and detailed needs of the user.

3. Maximising Mobility Mobility is central to independence and, for a large proportion of the UK's population, is achieved by the use of private car. While many older people continue to drive, relatively little is known about the requirements of the older driver. We need a better understanding of the effects of visual impairment, increased reaction time, reduced physical strength and personal mobility. Public transport is generally poorly accessible to elderly and disabled people. Improved information systems are also necessary to reduce waiting times and delays in physically uncomfortable and potentially unsafe places.

- 4 Development of telehealth and telecare approaches. Telehealth, allowing the easy collection and transmission of important physiological parameters can play a major part in the promotion of healthy ageing and in the remote monitoring of pathology. Telecare,

when IT methods can be used to monitor the life and safety of an older person living at home, is a vital component in the development of assisted living solutions.

- 5 Encouraging Innovation There have been many, many top down approaches to resolving some of these problems – however the vast majority of these either take years or even decades to become adopted best practice (if ever). We need to create a system where frontline initiatives are encouraged, supported by appropriate standards, and once tested, become the expected practice and the old way of working must be defended. An active approach like this might help reposition the UK as an early adopter and a place where new products services are launched – rather than the place where new devices are rarely originally launched. We need an open structure to encourage innovation and its implementation.