

## Grand Challenge in Assisted Living – Home Care Technologies

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### Context

The problems arising from an ageing population have been recognised at the highest level. In the UK, for example, older people in 2000 accounted for 24.4% of the population – the ratio of older people (65 or over) to those of working age (16 to 64). By 2050 this ratio in the UK is estimated to rise to 39.2%. This pattern is being repeated across all developed countries.

It is economically infeasible for society to provide specialised care facilities for such a large number of people. For example, the cost of looking after someone in a UK care home is about £24k p.a. Delayed discharges cost the NHS over £100m p.a. Hospital readmission for older people has risen by over 30% in the last 20 years due to lack of the right support at home. It is socially undesirable for older people to leave their own home and enter a care facility – especially since older people are increasingly healthy and more able to look after themselves.

There is therefore a strong need to support assisted living (i.e. health and social care delivery to the home). This may be desirable for the end user for a variety of reasons: reduced capability due to ageing, a long-term medical condition, a physical or mental disability. A strong element of human involvement must remain in care delivery. However, appropriate technologies have been shown to help people receiving care at home. This approach informs the dialogue of care, provides users with advice, identifies trends or anomalies that may require intervention, monitors potentially undesirable situations, provides reassurance to family members and informal carers, and relieves professional carers of routine low-level monitoring tasks. The promise of home care technology is recognised in many countries.

Technologies in support of home care go under a number of labels. Assisted living refers to devices and services that allow users to prolong independent living at home. Telecare refers to home-based devices and services that support daily life, but with a remote link to support services such as call centres. Telehealth (Telemedicine, e-Health) refers to remote monitoring, consultation and diagnosis of health issues. Telehealthcare includes aspects of both health and social care.

Assisted living exploits computer-based systems to support delivery of care to the home. Such systems should be appropriate (from different stakeholder viewpoints), customisable (for specific user needs), flexible (offering a range of solutions), and adaptive (as care needs and conditions evolve).

### Vision

The goal is to develop stakeholder-driven computing solutions for assisted living in conjunction with all relevant parties: scientists and technologists, end users, care professionals, informal carers, policy makers. The idea is to support, promote and enhance the care of those who wish to prolong independent living at home. This grand challenge lies at the intersection of computing, technology, healthcare and social care. It requires input from many researchers through an integrated, multidisciplinary approach. It is necessary to undertake and integrate a wide range of research to achieve solutions that are acceptable, practical and cost-effective from the viewpoint of end users as well as of carers.

### Challenges

The following computer science challenges arise in the field of assisted living:

- **Sensing:** gathering evidence of well-being from the user's activities of daily living in the home and its environment. Current sensors often cannot identify information that is relevant to care.
- **Information:** effective collation, integration, interpretation, presentation and distribution of data from many sources. This needs to be tailored for all the stakeholders who have an interest in, or an influence on, home-based care. It also needs to be presented in a way that contributes to the dialogue of care.
- **Interaction:** supporting effective communication between stakeholders and automated care systems.
- **Personalisation:** recognising individual care needs and their evolution over time. This requires computing support for home-based self care to be customisable, adaptable and flexible.
- **Analysis:** feature identification, trend analysis, interpretation and visualisation of the information collected. The data from assisted living is often 'noisy' and not amenable to conventional data mining.
- **Confidentiality:** appropriate measures to support individual privacy and dignity, confidentiality, information and network security, and appropriate use of sensors and data collection.
- **Integration:** interoperability among home-based devices, and also with external professional systems. The approach must integrate with the practices of professional care providers (e.g. call centres, NHS 24).

The following social challenges arise in the field of assisted living:

- **Societal:** adapting to changing demographics, managing changes in expectations of care at home, and supporting self-care in ways that are safe, acceptable, personalisable and effective.
- **Economic:** addressing the rising cost of care for an ageing population.
- **Professional:** enabling users to live independently at home for longer than currently possible. Existing models of care break down when the direct link between user and care professional is broken.
- **Organisational:** introducing new methods of care delivery as an extension of professional care facilities. Many solutions have failed to become integrated with normal service delivery due to lack of attention to this. It is also necessary to support the increasing need for remote care delivery.

### Fit to Grand Challenge Criteria

In terms of the criteria established for grand challenges, this proposal is politically comprehensible, publically understandable, unarguably challenging, universally engaging, and interesting on a 20 year timescale. More specifically, it meets the expected criteria for grand challenges:

- **Curiosity:** developing an understanding of techniques, technologies and procedures to underpin effective support for those receiving care at home
- **Engineering:** realising interoperable, automated computing solutions that can be brought to market.
- **Measurability:** readily assessed by acceptability to users and carers, degree of uptake, and range of commercial products and services.
- **International:** assisted living technologies have been recognised globally as a promising solution to support the ageing population.
- **Comprehensibility:** virtually everyone will be aware of the difficulty of caring for an older relative, and many will have first-hand experience of the stress of providing informal care.
- **Established:** assisted living is a relatively recent concept, but caring for older people is a long-established and worsening problem.
- **Evolution:** existing research and products have shown the promise of assisted living, but a substantial new initiative is required to address the challenges and to make assisted living a reality.
- **Cooperation:** close collaboration is needed among many research disciplines, social and health care professionals, end users, informal carers, commercial partners, and policy makers.
- **Competition:** a competitive position already exists due to the emergent and differing philosophies among research teams and early commercial products.
- **Decomposition:** it is possible to break this grand challenge down into clearly defined objectives, deliverables, and individual challenges of a wide-ranging nature.
- **Paradigm:** a fundamental re-think is needed of care delivery. The balance of care is shifting from the State, the NHS and Local Authorities to lie closer to the individual and the community.
- **Research:** current assisted living products are technologically limited and do not interoperate. Market pressures will not resolve this, so scientific advances and standardisation are urgently required.

### Programme

The aim is to establish a programme of fundamental and applied computing research that addresses the challenges outlined above. In view of the diverse issues in assisted living, this programme will require active collaboration among researchers, developers, users and professionals. The programme will yield new insights into many areas that pervade computer science and its application in other fields. Concretely, advances will be made in technical areas such as sensor technologies and networks, human-computer interaction and interface design, service-oriented frameworks and service platforms, data analysis and visualisation, information and network security, and system interoperability. The ultimate aim is an architecture, a computational framework, and an extensive set of interoperable components to support home-based self care.

### Beneficiaries

Success in this grand challenge will benefit many people through improved home care and support. The primary beneficiaries will be those receiving care at home, usually because they wish to prolong an independent life there. Academic researchers in many areas will have the opportunity to conduct innovative and world-leading research in an exciting new field. Care professionals will gain through reduced demands on their time, particularly for routine monitoring tasks. Care providers will see economic and practical benefits through a decreased need for care facilities (e.g. nursing homes, hospital beds). Informal carers (e.g. relatives or neighbours) will find their role less stressful and time-consuming due to improved information and reassurance about the person in care. Commercial developers will have access to a very large market for care products and services, estimated to be worth billions of pounds in the UK alone. Policy makers will receive accurate information about care needs and effectiveness of care delivery, and can expect to see significant cost savings.