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COMMENTARIES

Technology in geriatrics

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Abstract

Recently, the interest of industry, government agencies and healthcare professionals in technology for aging people has increased. The challenge is whether technology may play a role in enhancing independence and quality of life and in reducing individual and societal costs of caring. Information and communication technologies, i.e. tools aimed at communicating and informing, assistive technologies designed to maintain older peoples' independence and increasing safety, and human–computer interaction technologies for supporting older people with motility and cognitive impairments as humanoid robots, exoskeletons, rehabilitation robots, service robots and companion-type are interdisciplinary topics both in research and in clinical practice. The most promising clinical applications of technologies are housing and safety to guarantee older people remaining in their own homes and communities, mobility and rehabilitation to improve mobility and gait and communication and quality of life by reducing isolation, improve management of medications and transportation. Many factors impair a broad use of technology in older age, including psychosocial and ethical issues, costs and fear of losing human interaction. A substantial lack of appropriate clinical trials to establish the clinical role of technologies to improve physical or cognitive performances and/or quality of life of subjects and their caregivers may suggest that the classical biomedical research model may not be the optimal choice to evaluate technologies in older people. In conclusion, successful technology development requires a great effort in interdisciplinary collaboration to integrate technologies into the existing health and social service systems with the aim to fit into the older adults' everyday life.

Keywords: *aging, gerontechnology, information-communication-technology, assistive technology, robotics, older people*

The recent demographic transition with the increase in the number of older persons with disabilities, the growth of costs of healthcare and the rapid technological development particularly in consumer electronics, communication, home automation and robotic solutions, brought an increasing interest of industry, government agencies and healthcare professionals in technology for aging people.

Indeed, the crucial challenge of today is whether technology may play a role in enhancing independence and quality of life and in reducing individual and societal costs of caring by preventing and managing disability and frailty of older individuals [1].

Which technologies?

Information and communication technologies (ICT), assistive technologies (AT) and human–computer interaction technologies (HCI) are nowadays active interdisciplinary topics both in research and in clinical practice. Information and communication technologies include tools aimed at communicating and informing, i.e. internet systems, telephone-based support groups, webcams, videoconferencing, online computer services and electronic medical-health records [2]. Assistive technologies include computer-based tools designed to maintain older people's independence and increasing safety. In detail, assistive technologies include (i) behaviour monitoring tools, i.e. sensors and warning systems that alert caregivers whenever the care recipient changes location or behaviour, (ii) smart homes tools, that predict abnormal and potentially dangerous behaviours and (iii) telehealth or telemedicine tools, including passive monitoring systems, remote data exchange between patients and caregivers or healthcare professionals, and video systems that allow patients to interact with other people staying inside the home [3]. The specific aim of human–computer interaction technologies is to create assistive robotics, including robots for supporting older people with mobility or cognitive

limitations, humanoid robots, exoskeletons, rehabilitation robots, service robots and also companion-type robots that perform physical and mental activities with the aim to maintain healthy life habits of the older people by engaging their users to develop training activities in physical and mental activities and rehabilitation [4, 5].

Clinical applications

Housing and safety

Current healthcare and social policies encourage the concept of 'aging in place', where the older people remain in their own homes and communities, because this is considered to be the best solution in terms of health, quality of life and social connections of old people, as well as in economic terms [6]. At the same time, the World Health Organisation defined older people living alone as an at risk group which should be targeted for specific attention. In this context, domestic appliances of devices or systems that controls and manages the physical environment may play a role to maintain and improve the functional capabilities of people with physical and cognitive impairments. Moreover, telecare facilities can be combined into a lifestyle reassurance package with bed and chair occupancy sensors, passive infra-red movement detectors, a 'safety package' that includes intruder alarms, flood detectors, extreme heat detectors and fall detectors. Data from a European multicentre survey suggested that information and communication technologies and assistive technology devices could be useful to improve the quality of care and safety of older patients with Alzheimer's disease (AD) by monitoring bed rest and movements, medication use, ambient environmental conditions and emergency communication [7]. Interestingly, relatives and/or caregivers of AD patients reported that technology systems could be significantly more useful for AD patients aged 75–84 than patients aged <75 or ≥85 years ($p < 0.0001$) and with moderate than mild or severe grade of dementia ($P < 0.0001$). Moreover, relatives/caregivers aged more than 50 years and with low educational level considered technological systems more useful than relatives/caregivers aged <50 years ($p < 0.0001$) and with high educational level ($p < 0.0001$). These findings suggest that age and severity of cognitive impairment of patients as well as age and educational level of their caregivers could significantly influence the efficacy of technologies in improving the at home management of patients [7].

Mobility and rehabilitation

Several studies reported that sensors and robots may assist older subjects to improve mobility and gait. The potential usefulness of these technologies to support the care of older patients could reduce healthcare load and costs secondary to care needs and premature institutional care of subjects with impaired functioning due to trauma or even with chronic diseases [6].

Very recently, the brain–computer interface (BCI) demonstrated an exciting advance in neuroscience and engineering. In a motor BCI, electrical recordings from the motor cortex of humans are decoded by a computer and used to drive robotic arms or to restore movements in a paralysed arm by stimulating the muscles in the forearm. Simultaneously, integrating a brain–computer interface with the sensory cortex will further enhance dexterity and fine control. Some ongoing multicentre clinical trials will inform on the clinical application and impact on the care of people with disabilities by such a technology [8].

Communication and quality of life

Technologies could improve communication and the quality of life of the older people and their caregivers. This has been successfully explored in older patients with AD who are dependent in most daily living activities [7]. Recent findings suggested that the use of information and communication technologies allow the older adults to maintain their independence by reducing isolation, improve management of medications and transportation and thereby significantly contribute to improving quality of life and social inclusion [9]. Technologies may improve quality of life of caregivers by reducing caregiver burden. Recently it has been reported that assistive technologies are effective in reducing time, levels of assistance and energy put towards caregiving, decreasing anxiety, fear and task difficulty and in increasing of safety in performing activities requiring physical assistance [10]. Most of the findings, however, derive from qualitative and not-controlled studies. The lack of quantitative evidences suggests that further research is required to better understand the effectiveness as well as limitations of using technologies in order to appropriately evaluate the cost–benefit ratio for supporting their use in reducing caregiver burden.

Gerontechnology: a challenge or an opportunity for the older people

Many factors impair a broad use of technology in older age, including psychosocial and ethical issues. Indeed, most of technology solutions demonstrated a clear intrusive nature that emerged privacy-related issues, acceptance, cost-related social stigma and also fear of losing human interaction [11, 12]. Moreover, ageism through a prejudicial negative view of the digital divide between older and younger people, and the time of technological intervention, in relation to the clinical and functional conditions of subject, may influence adherence to the use of new technologies.

Despite a great interest in aging and technology research, the field continues to be fragmented, lacking a clear conceptual basis, distinct identity and future directions. Possibly because gerontechnology involves multiple scientific disciplines such as geriatric medicine, psychology, social sciences, computer sciences, engineering and design, informatics and economics, it is difficult to establish general agreed methodological standards for evaluating technology in clinical practice.

Indeed, recent meta-analyses reported that many technological interventional studies targeting older people lack of

quantitative health outcomes as a part of their evaluation process and that there is a lack of consensus as to which outcomes to use [13]. Similarly, a substantial lack of appropriate clinical trials to establish the clinical role of using sensor and robotic technologies to improve gait and mobility of older people has been reported [5]. Also, Cochrane database reviews highlighted the current lack of evidences to support or refuse the use of smart home technologies within health and social care, which is significant for practitioners and healthcare consumers [14] as well as to determine whether information and communication technologies and assistive technologies are effective in supporting older people with dementia to manage their memory problems [15].

An integrated multidisciplinary approach is the solution

Successful technology development requires a great effort in interdisciplinary collaboration. The involved teams include either clinicians, social and behavioural scientists, physiotherapists and psychotherapists, engineers, computer scientists, designers, as well as end-users and policy experts. Moreover, integrating technology into existing organisations and operational systems, and the workflow of clinicians is as important as developing the technology itself. Technology is not a single device that helps to carry-out specific tasks. In order to be truly effective, the technologies need to be integrated into existing health and social service systems with the final aim to fit into a personalised and comprehensive older adults' everyday life.

Most probably the classical biomedical research model for evaluating the efficacy or effectiveness may not be the optimal choice due to the rapid evolution of technologies. Indeed, public health systems and private insurers are reluctant to adopt and pay for technology without appropriate cost–benefit analyses. Generating such data often requires long and high expensive randomised trials, which technology developers cannot afford. Maybe, small-scale trials or rapidly executed studies could play an important role in the technology development and evaluation processes.

Technologies to support older individuals will continue to be developed and marketed with or without our input. As geriatricians we have the important task to help the development process and to evaluate the evidence-based results on the effectiveness of technologies for the older people. These are important functions that will accelerate the development and dissemination of cost-effective systems that enhance the functioning, independence and the quality of life of a rapidly growing older population [1].

Key points

- Technology may play a role in enhancing the independence and quality of life and in reducing the individual and societal costs of caring by preventing and managing disability and frailty of older individuals
- Information and communication technologies (ICT), assistive technologies (AT) and human–computer interaction technologies (HCI) provide innovative solutions to improve housing, personal safety, mobility, rehabilitation, communication and quality of life of both older subjects and their caregivers
- Psychosocial and ethical issues, acceptance by end-users, costs and the time of intervention may impair a broad use of technology in older age
- A great effort in interdisciplinary collaboration is necessary to integrate technology into existing health and social service systems

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Conflict of interest

None.

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Towards a toolkit for the assessment and monitoring of musculoskeletal ageing

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Abstract

The complexities and heterogeneity of the ageing process have slowed the development of consensus on appropriate biomarkers of healthy ageing. The MRC-Arthritis Research UK Centre for Integrated research into Musculoskeletal Ageing (CIMA) is a collaboration between researchers and clinicians at the Universities of Liverpool, Sheffield and Newcastle. One of CIMA's objectives is to 'Identify and share optimal techniques and approaches to monitor age-related changes in all musculoskeletal tissues, and to provide an integrated assessment of musculoskeletal function', i.e. to develop a toolkit for assessing musculoskeletal ageing. This toolkit is envisaged as an instrument that can be used to characterise and quantify musculoskeletal function during 'normal' ageing, lend itself to use in large-scale, internationally important cohorts, and provide a set of biomarker outcome measures for epidemiological and intervention studies designed to enhance healthy musculoskeletal ageing. Such potential biomarkers include: biochemical measurements in biofluids or tissue samples, *in vivo* measurements of body composition, imaging of structural and physical properties, and functional tests. The CIMA Toolkit Working Group assessed candidate biomarkers of musculoskeletal ageing under these four headings, detailed their biological