Strengthening the Role of Medical Informatics in Promoting a Successful Positive Aging

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Abstract: - Ideas about aging have changed over time. Improvements in medical treatments, technology, science and living conditions have resulted in people living healthier and more active lives longer. Aging people are increasingly becoming computer literate and more willing to be empowered about their own state of health and way of living. This paper presents the most important features of promoting a positive aging with the help of medical informatics. There is a real need for complete and intelligent integrated solutions able to provide customised support for aging people. This is in accordance with their specific needs by means of friendly, adaptive ICT technology and it must take into account the uneasiness many aging people have when interacting with technology because of lack of familiarity, lack of training, and difficult-to-use systems. Medical informatics facilitates healthy aging and lifelong vitality and promotes independent living as people grow older. AGECVD, a health informatics system, proposes a complex integrative approach of physiological aging and atherosclerosis processes which can determine a multitude of cardiovascular events.

Key-Words: - Aging people, Design for all, Empowerment, Aging Friendly ICT Technology

1 Introduction

The percentage of aging people on the total of the world population is rapidly increasing, leading to remarkable effects on the social structure and the health service. This dramatic growth in numbers and proportions, increased life expectancies, and energetic life styles, now enables us to live 20 to 25% of our lives in active retirement. Moreover, today's physically and intellectually active younger generations predict that tomorrow's elderly population will be better educated, healthier, culturally literate and, as individuals, more discerning consumers.

Demographic changes are creating a new society, and these profound social changes form a new reality: fewer young people, older workers, pensioners and very elderly people, composition of families (particularly evident in the growing number of seniors living alone). Therefore it is compulsory for the aging people to remain active and healthy as long as possible. There are many opportunities to be realized as future generations of older people are expected to be healthier, more skilled and educated, and remain more active in the workforce than their predecessors. They are consuming more new goods and services and want to participate actively in social life. Unfortunately, for some aging people, full participation in society is prevented through low sense of worth or because of restricted opportunities.
The concept of "positive aging" embraces a number of factors, including health, financial security, independence, self-fulfillment, community attitudes, personal safety and security, and the physical environment. Society as a whole has a lot to gain from these outcomes: a healthy, happy, and confident aging population contributes a wealth of expertise and skills to the community and the workforce, places less demand on social services, and provides positive role models for younger generations.

Even though the term “elderly” is accepted in many domains, it has negative connotations and evokes such negative stereotypes. Negative stereotypes also exist about aging people’s attitudes and capabilities regarding technology. However, many older adults embrace new technologies and see benefits to using technologies [1]. New ICT technologies, designed with an explicit focus on the needs of older adults, as well as their clinicians and family caregivers, can help to meet the challenges of an aging global population.

Aging people are receptive to the concept of healthcare technology, as long as it continues to provide them with a sense of control and empowerment. The elderly want to retain control over their lives and be involved in decision-making about their care.

The objectives of medical informatics are to contribute to a high-quality healthcare (especially patient care) and to the gaining of new medical knowledge. By helping aging people to become more proactive in managing their health, and providing caregivers with the tools and information they need to deliver care in any setting, from the home to the hospital, medical informatics can play an important role in addressing the needs of the coming age wave.

Health informatics systems, like AGECVD presented in this paper, can have an important contribution in reaching a positive and healthy aging, with benefits both for individuals and for our nowadays aging society.

2 Risk factors that affect our aging population

Aging people are not homogenous and have various interests and competences. They have changing disabilities, sometimes they are (or feel) isolated and excluded, they have the impression being useless and they are often overwhelmed by technology.

Facing the ICT technology, the most common risk factors that affect our aging population are:

- Digital literacy is considered nowadays one of the essential skills to allow people to effectively take part in the modern society and to be involved in taking decisions about their own lives. Digital divide is considered the gap between those who have access to and use the potentialities of ICT for their own achievements, and those who are not in a position to access or use these potentialities. Elderly people are often intimidated by the use ICT due to: their lack of digital literacy, limitations imposed by their physical and mental disabilities, cost, geography, usability, including interface issues that arise from age-related disabilities.
- In some countries, the most important obstacle using the new technology is the economic situation, which does not allow older people to buy it.
- Many older persons do not have the support of work colleagues or an IT department, and may need to learn to use new technology on their own, perhaps with the help of friends/family.
- The anxiety that can result from coming into contact with something new might be quite a challenge for aging people in using ICT technology.
- Aging people are often considered as a source of problems rather than a group still able to give their contribution to the social and cultural life.
- The early retirement as well as the decline of employment percentages for people 50 years old and over can be found in most of the countries.

The likelihood of a person developing a disability or chronic illness increases with age. Many older adults are disabled in one or more aspects of self-care and, in general, the elderly require more health care services and incur higher health care costs than younger people. As the elderly population increases and people live longer, more people will require help with aspects of daily living and disease management. [2] The new aging people want to be active, mobile and self reluctant as far as possibly. The elders of the future will have better financial resources and higher levels of education than before.

3 The positive aging, a worldwide goal

Positive aging is a term used to describe the process of maintaining a positive attitude, feeling good about yourself, keeping fit and healthy, and engaging fully in life as you age. Somen researchers and policy makers feel that enough time has been spent on the negative aspects of aging and that the balance should be addressed by analyzing successful, or positive aging (sometimes defined in terms of an overlapping but separate dimension
Aging is often associated with many rewarding experiences. It is, however, also a time when significant changes might occur. Elderly people are most vulnerable to social exclusion.

There are a number of ways to prevent, delay or manage some of the physical, psychological, social and personal challenges people face as they age – some of these are mentioned below:

- **maintaining a positive attitude** – it’s important that aging people can make choices and have control over important aspects of their life;
- **preventing digital exclusion** - i.e. to prevent that they could be left behind of the information society;
- **continuing working or to combine part-time work with retirement** - therefore the main objective of new policies should be the augmentation of employment rates at an older age;
- **keeping the brain active, alert and flexible** – this can promote good mental health and positive aging throughout the lifespan;
- **staying connected** - social interaction and relationships with others;
- **being empowered regarding their own health** – this implies access to information and knowledge and it has as a result a better healthcare and self-esteem.

All these can be accomplished with the help of new policies and ICT technologies adapted to the aging population. European Commission established for the period 2007-2013 the programme “Europe for Citizens”. The implementation of preventive policies like the effective use of ICT can raise awareness of aging people about the possibilities and benefits the use of ICT can bring for them. The 2007 European Commission Communication "Ageing Well in the Information Society" supports EU policy in the areas of growth and competitiveness. It presents an action plan that considers ICT for aging well as both a social necessity and an economic opportunity. ICT technology represents a compulsory help for reaching a positive aging.

### 4 Aging friendly ICT technology

A survey of the current literature reveals that recent technological advances have been made in the fields of "telecare and home-monitoring", "smart homes and robotics" and "health information systems and knowledge management". Innovative technologies such as wearable devices, bio and environmental sensors and mobile, humanoid robots do already exist and ambient assistant living environments are being created for an aging society. Services based on ICT technologies are already part of everyday life.

Research has shown that ICT technology can radically improve the quality of life of aging people. However, the complexity and novelty of many new devices and services run the risk of rendering the majority of aging people unable to use them. In the same time, with ever-changing advances, ICT technology often creates a divide between generations, isolating many seniors from the younger generation and from key information and resources needed to function. Aging friendly ICT technology aims to further integrate elderly persons into society and reduce social isolation by working to increase access, capacity and knowledge of technology among this population.

In order to obtain a successful positive aging with the help of ICT technology, it is compulsory:

- to design new ICT technology for a better inclusion of these socially disadvantaged people, that would take into account their special needs;
- to identify key ways or roles that the aging people can play in the design process;
- to formulate user requirements for an appropriate design taking into consideration the cognitive, sensory and psychomotor changes;
- to understand factors that influence elderly adoption and acceptance of technologies;
- to train and support them, so that the technological barriers would be marginalized;
- to raise affordability (low cost of ICT technology);
- to improve graphical icons so that their functions are easy for aging people to understand. Icons are very important because they convey language and concepts that users need to understand in order to learn to use the application;
- to provide additional interactive guidance back to help them learn to use ICT technology.

Aging friendly technology easily-accessible worldwide should be created by taking into consideration the designing for all. The „Design for All” concept is based on an understanding of design in which the shaping of the built environment is oriented towards people (human-centred design approach). It is a concept which consists of three strategies: (1) products/services and applications should be usable by as many people as possible, regardless of age, ability or situation, without any modifications. (2) products should be easily adaptable to different users. (3) products should have standardized interfaces, capable of being accessed by specialized user interaction devices.
Designers are trying to fit ICT technology in the lives of the elderly and aging people, and make it as pleasant in use as possible. As an example there is gerontechnology, a combination of gerontology and technology. It’s designing technology and environment for independent living and social participation of older persons in good health, comfort and safety.

While ICT technology is rapidly being integrated into most aspects of life, changing the nature of work, the form and scope of personal communication, education, health care delivery, and home, aging people are highly likely to be active users of technology. Alongside a social objective, designing aging friendly ICT technology is also increasingly gaining an economic perspective, as aging people have become an important customer group. Knowing the needs of older consumers and considering these in the development and design of products and services promises competitive advantages and market success.

5 Reshaping our medical informatics in a sustainable and aging people-centered manner

Health is one of the most demanding issues for aging people. This also extends to the design of medical applications; aiding memory, monitoring health conditions, and supporting communications with distant family members are exemplary applications supporting elderly persons [9] In the nowadays society it’s more likely to find aging people which suffers more from chronic conditions than acute or infectious diseases, and long-term community care is frequently more appropriate than short-term hospital care. There is an emerging public attitude towards a new concept of health, i.e. one that not only includes the treatment and prevention of disease, but also the promotion of health and wellness and the concept of personal responsibility for it.

The use of ICT is becoming a self-evident part of the development and delivery of healthcare services. In fact, it has been proved that empowerment of the patients and technology have become critical elements of the healthcare of aging people. ICT technology has to be adapted to aging people's self-care processes and coping strategies, and to support new ways of healthcare delivery.

Medical informatics can support this process by providing the necessary information infrastructure, contribute to standardisation, interoperability and security issues and provide modelling and simulation techniques for educational purposes. It help clinicians and healthcare providers to make complex information useful in supporting clinical decisions, thus delivering the best standard of care for each patient. Medical informatics has the potential not only to make the provision of healthcare more efficient and cost-effective, but to encourage the independence of aging people and to improve their communication with doctors and other health professionals.

Here are some examples of types of aging people-centered medical informatics: Relational databases that facilitate the retrieval of data for multiple purposes; Manipulation of data to create information and knowledge; Health informatics systems used for: diagnostics (internet consultations and telemonitoring), therapy (rehabilitation and telecare); Point-of-care devices, computerized patient records and/or electronic health records; Clinical repositories as a strategic resource for quality and practice; Electronic interfacing systems to facilitate the sharing of data; Acquisitions, storage, transmission, processing, analysis of digital images of the body and providing help to integrate those images in the various parts of the treatment; Virtual patient visits via video conference or vital sign monitoring; Health education informatics systems for lifestyle management.

5.1 Design recommendations for sustainable medical informatics

The aging population has lagged behind younger generations in the adoption of ICT technology, including the use of it for seeking and understanding health and medical information. Age differentials within the elderly population are important. In designing aging people-centered medical informatics, the following recommendations must be taken into consideration:

- the technology must be transparent to the elderly;
- it has to be reliable and secure;
- it should adapt to age disfunctionalities - the user’s limitations (cognitive and motor) and impairment (visual and hearing) are important in inserting specific features;
- it has to support the independence of aging people and empower them to control over their lives;
- the user interface must be adaptable. Aspects to consider when designing the user interface for elderly users are readability and presentation of information, navigation through the website, incorporation of multimedia, and evaluation of system accessibility and friendliness. These include, for example, simple and clear pages, clear navigation mechanisms, large buttons, large font.
sizes, conservative use of colours and avoidance of deep hierarchy in the information structure;

- the active involvement of future users of the application being developed (participatory design). Participation design is closely linked to patient empowerment and motivation to using the system.

The benefits of medical informatics include the ability of healthcare consumers to better manage their health. This can be achieved by the availability of modern healthcare tools such as web sites providing reliable healthcare information, Internet based health decision tools, online support groups, and personal health records. The operation of the healthcare system will increasingly depend upon the acquisition, analysis and dissemination of reliable information.

Designing health informatics systems must take into account the evolving nature of the health domain and the aging of the population, a growing trend towards primary and preventive care and the explosive growth in global networking. While, historically, storage and retrieval of data has been the main target for informatics systems development, the need to capture knowledge itself is becoming the focus for HEIS development.

5 Study Case: AGECVD

The research project “Complex Study of Metabolomics, Genomics, Epigenetics of Age Related Atherosclerosis and Cardiovascular Pathology – AGECVD” is designing a protocol of investigations, diagnosis, treatment and monitoring of atherosclerosis and cardiovascular diseases specific of aging and it is developing a system of health information for collecting and analyzing results of biomedical investigations and psychosocial surveys. Structural and functional changes of the cardiovascular system occurring in the course of aging are involved in increasing the risk of developing atherosclerotic processes and cardiovascular diseases. Physiological aging as well as the atherosclerotic process is associated with a state of low chronic inflammation and enhanced oxidative stress, which suggest that pro-inflammatory cytokines and the balance between oxygen reactive species generation and antioxidant defense play an important role in aging and atherosclerosis. Prevention and delay of changes associated with advancing age diminish the risk of developing cardiovascular diseases, thus enabling a healthy aging in the context of a continuously increasing average human life span.

AGECVD is a research project developed inside the National Research, Development and Innovation Plan for the period 2007-2013 (NP II) is the main instrument by which the Romanian National Authority for Scientific Research (NASR) is implementing the National Strategy for RDI.

Objectives: establishing markers that predict the risk of atherosclerotic processes developing and progressions’ as involved with aging related cardiovascular (CV) diseases and in view of a larger range of preventive strategies, which might contribute to elderly’s health condition improvement; creating a framework to facilitate transfer of data, information, knowledge; supporting and providing arguments for the novelty of an integrative approach on aging related atherosclerotic processes that impact health condition and life expectancy increase; establishing correlations of metabolic, inflammatory status, oxidative stress parameters, life style; establishing associations with genes implicated in methyl group metabolism pointing out newer predictive/risk factors of developing atherosclerotic processes and cardiovascular events in the course of aging; design of therapeutic strategies, particularly to prevent developing cardiovascular diseases with increased risks of mortality in the elderly; dissemination of research outcome, organizing an open space for informing specialists and individuals of the general public with interests in preventing and treating causes of pathology induced aging; continuous updating knowledge on atherosclerotic processes’ complexities and CV pathology by use of a health informatics application which ensures a higher degree of flexibility to changes and efficiency in handing over information.

Methods

For designing a health informatics application available on the internet able to load, store and for processing results of biomedical investigations, psychosocial survey, hence to facilitate dissemination of results, communication with specialists involved with the project and the general public, an important accent was put on usability and creating an open informational space. AGECVD is a health informatics system that comprises an interconnected database system. It has an architecture that is structured into modules, allowing that new functionalities could be easily added. The problem of the technical accessibility is solved by using a web-based solution, a web browser being the only necessary condition for the user to connect to a system, with no need for other applications. It is a person-centric health informatics system with a high degree of flexibility because of dynamic and integrated structure that will accommodate to various health changeable and needs of society in
general and individuals in particular. To facilitate the access to information regardless of the user’s skills, there are provided clear navigation elements, perfectly adapted to the way in which links between pages are established, which provides visual clues about their function and which helps to orientation. In terms of software architecture, the Model-View-Controller concept is used to ensure separation between user interface and objects that implement the logic of application. This approach has allowed the independent testing of application components. By using framework software Spring, Acegi and Hibernate embedded in a single container we managed to centralize and to manage automatically the configuration of application objects, thus ensuring the scalability of the implemented solution.

Results
The practical results of AGECVD put into value the pointing to physiological aging newer markers and predictive factors of developing atherosclerotic processes in the course of aging; design of molecular target therapies; elaboration of a complex protocol of investigations, diagnose and treatment as resulted from statistical analysis correlations of obtained biomedical data; application of the information technology in the research field of aging and large of care, access to education, efficiency and time savings. Information provided by this system meet the qualities that gives it a high quality standard, namely: opportunity, timeliness, accuracy, completeness, availability, validity, different ways of presentation. The performances of this health informatics system take into consideration the user-friendly interface, safety functioning and data, high response time. It is a system characterized by modularity, flexibility, platform independence, dynamism, accessibility, multidisciplinary, interoperability and it respects the main tendencies of developing the health informatics systems. This project is feasible because of its complex research methodology, scientific and technical particularities, quality of information, accessibility, high performance, mainly in the research topic of molecular medicine, genomics based methods of investigations and interventional methods and because of the multidisciplinary partnership.

7 Conclusion
Aging means increased social capital and new attitudes towards the aging people which have changed and significantly differ from recent past. In this changing society, to achieve a positive aging is an important goal, in order to improve people’s well being and the society as a whole. Aging people are becoming more accustomed to using information society services and at the same time older people are a remarkable consumer group. As ICT technology develops and brings new innovations, it will be important to remain focused on the needs of aging users with respect to their computer access and use, and their attitudes towards and acceptance of the technology. Issues such as ‘design for all’ complemented by participatory design will help to stimulate patient empowerment. An aging population, increased longevity and co-morbidity of diseases have put enormous pressure on health care systems globally. Innovative ways to address this strain are needed. By understanding the characteristics, demands and needs of aging people and including them in the design process, medical informatics can be developed to circumvent difficulties, maximize the usability and usefulness of products and technologies, hence supporting successful positive aging.

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