

# Becoming a Digital Citizen in an Aging World

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**Abstract**—A digital citizen commonly refers to a person that participates in society using a certain amount of information technology. Global aging has numerous complex effects on society, an important one being the concern about the impact on healthcare demand. A successful aging consists of three components: low probability of disease or disability, cognitive and physical function capacity, active engagement with life. Sustainable Health Information Tools are needed to provide the evidence required for better planning, for informed decision making at different levels as health promotion through primary prevention, prevent readmissions through improved self-care, improved self-management of chronic conditions. They can have the potential to play an important role in achieving well-being, independent living and delaying of the aging process. “Multidisciplinary Complex System for the Efficient Management of the Anti-Aging Information – AgingNice” is a health education information system that enables an environment for developing an efficient age management, aiming to provide reliable, relevant, and understandable online health information for different type of users, for promoting the results of the specific scientific research, for strengthening the link between the medical staff and the patient by increasing the citizen’s informing degree.

**Keywords**—Accessibility, Active aging, Citizen, Health education information systems.

## I. INTRODUCTION

The Age of Aging explores a unique phenomenon for mankind and, therefore, one that takes us into uncharted territory. [1] People are living longer and, in some parts of the world, healthier lives. An important feature of population aging is the progressive aging of the older population itself; over time, more older people survive to even more advanced ages. Some countries are witnessing a historically unprecedented demographic phenomenon: simultaneous population aging and population decline. [2] While global aging represents a triumph of medical, social, and economic advances over disease, it also presents tremendous challenges to which society must be prepared.

A citizen-driven society is a society in which the emphasis is on individual. His actions are based on self-determination, self-responsibility and access to information and knowledge. Making his own decisions, taking actions and being responsible for the consequences implies first being informed, and this can

be done with the help of the advances in Information and Communication Technology (ICT) that enhance the ability of the citizen to inform himself and through the rapid and easy dissemination of the information.

This must lead to the development of tools and environments in which necessary information can be obtained and used whenever needed, fairly, easily, and safely, to create a society that can support lives and connections among people.

Among all technologies, Information Technology is the one that has a direct and constant influence on our lives. Our society is evolving around information technology, it is a "information society", and we are witnessing the emergence of a new culture – the digital culture. [3]

There is a need to invest in the smart use of technology and exploitation of information because they can help us to address the challenges facing society, like the aging population. This society, a digital one, must be envisioned as a society with better outcomes for all. The deployment of ICT is becoming a critical element for delivering policy objectives like supporting an aging society, climate change, reducing energy consumption, improving transportation efficiency and mobility, empowering patients and ensuring the inclusion of persons with disabilities. [4]

In most countries of the world, the elderly persons do not enjoy a decent status in society. Consequently, there is an urgent need to empower the elderly through implementation of mass action programmes and adapted ICT.

Empowering the seniors consist of enabling them in at least three spheres or dimensions of life, namely; economic, social, and health.

An aging population also increases the pressure felt by the healthcare system, as the demand for services rises. Health Education Information Systems aims to support the improvement of gaining knowledge and healthcare by increasing the capacity of citizens and health professionals to make decisions based on accurate, up-to-date and customized information. Knowing how to prevent diseases and how to delay some of the aging processes will prolong the active life, with long term benefits at the society level.

## II. RISK FACTORS AFFECTING OUR AGING SOCIETY

Although life expectancy has increased, it is unclear how long this trend will continue. The aging of the population should be seen as a transition, not a crisis, with opportunities as well as challenges in society's response to the aging problem.

The decline in the ratio of workers to pensioners causes a great burden on those who are still working. The main challenge is to promote healthy and active aging and to adjust societal practices and structures to include older people as contributors to society. It is important to use existing resources more effectively, that is to extend the retirement age and keep more people in work, fostering the participation and employment rates of elderly.

Another risk factor is the changing of the family structure. As people live longer and have fewer children, family structures are transformed. This has important implications in terms of providing care to older people.

Aging process often implies loss of status and social isolation. But the increasing number of older people might offer a growing market for education and training, as well for new technologies. Lifelong learning is important, not only for staving off cognitive decline and furthering personal development, but also for upgrading knowledge and skills that can be used in a prolonged active and healthier life.

The aging of the population has a major impact on the organization and delivery of healthcare. In the next 10 to 15 years, the loss of health and life in every region of the world, including Africa, will be greater from chronic diseases, such as heart disease, cancer, and diabetes, than from infectious and parasitic diseases. Aging persons are at risk for chronic conditions because of factors that cannot be modified, such as genetic predisposition or gender. Risk factors related to health behaviours, however, can be modified, promising significant returns in terms of better health for individuals and a longer, healthier life, if the citizens are better informed and if they become self-responsible.

The growth in aging population is occurring at the same time as an explosion in technology. Technology has also created challenges for some everyday activities such as banking, telephoning, and finding health information that may increasingly involve unfamiliar or different ways of doing things. Access, literacy, cost, design, privacy and attitudes play a role in how we choose to use technology.

All citizens should be made aware of the potential of ICT for making life easier, including elderly or people with disabilities. This calls for multi-stakeholder partnerships, increased learning, recognition about

digital competences in formal education and training systems, as well as awareness raising and effective ICT training outside formal education systems. [5]

While new ICT can worsen the exclusion experienced by aging and disabled persons in terms of their access to information and full participation to society, they can also provide extraordinary assistive solutions to empower them. New, proven technologies can enhance the lives of seniors and people with disabilities and support their rights as citizens and participants in their communities' social and economic activities - but only if these solutions are affordable.

The aging population is usually described as a threat or burden for society, but the economic potential of it and the role of elderly people as consumers, on the other hand, are widely neglected.

The new elders want to be active, mobile and self-reliant as far as possible. The elders of the future will have better financial resources and higher levels of education than before. They will possess large purchasing power and outspoken demands as consumers and as patients.

The term information literacy is generally defined as the ability to access, evaluate, organize, and use information from a variety of sources. Information literacy can no longer be defined without considering ICT literacy in order for individuals to function in a knowledge society.

The concept of ICT literacy includes both critical cognitive skills as well as the application of technical skills and knowledge.

This definition is also important in that it lists five critical components of ICT literacy. [6] The five components represent a set of skills and knowledge presented in a sequence that suggests increasing cognitive complexity:

- **Access** - knowing about and knowing how to collect and/or retrieve information.
- **Manage** - applying an existing organizational or classification scheme.
- **Integrate** - interpreting and representing information. It involves summarizing, comparing and contrasting.
- **Evaluate** - making judgments about the quality, relevance, usefulness, or efficiency of information.
- **Create** - generating information by adapting, applying, designing, inventing, or authoring information.

Although health literacy is a quite a new concept, it has quickly caught the attention due to its widespread impact on health and well-being. The vast majority of attention in health literacy research has been focused on information accessibility, namely the delivery and

readability of health-related information. Accessible information that one understands is a necessary but not sufficient condition for addressing health literacy. One's ability to use the information in making healthcare decisions based on the information accessed is also an important part of health literacy. Age-related changes may adversely impact health literacy.

Health literacy means being able to find, process, and understand basic health information and services needed to make appropriate health decisions. Health literacy is important because low health literacy is linked to poor health outcomes.

Inadequate health literacy is more prevalent among vulnerable populations, such as the elderly, minorities, persons with lower education, and persons with chronic disease

Health literacy varies by context and setting and is not necessarily related to years of education or general reading ability. A person who functions adequately at home or work may have marginal or inadequate literacy in a health care environment. With the move towards a more "consumer-centric" health care system as part of an overall effort to improve the quality of health care and to reduce health care costs, individuals need to take an even more active role in health care related decisions. To accomplish this people need strong health information skills.

It stands to reason that the most obvious approach to addressing low health literacy is related to making information more accessible. Without accessible information, there is no basis by which an individual, organization, or community can process messages to improve health outcomes.

### III. ICT SUPPORTING ACTIVE AGING IN A CITIZEN-DRIVEN SOCIETY

According to the World Health Organization, active aging is "the process of optimising opportunities for health, participation and security in order to enhance the quality of life as people age" [7]

Information and Communication Technology must have an important role in supporting citizens to be actively involved in any activity related to them, throughout their life, anytime and anywhere.

Nowadays, it is quasi-unanimously accepted that information represents a fundamental element in the structure of the universe along with matter and energy. Therefore, information technology has an overall major impact on daily life, seriously influencing all its facets: social, political, economic as well as private life.[8]

Citizens call for timely and high-quality information for reasons of awareness and personal well-being. (see Fig.1) Only an informed citizen will be in the position to participate in taking decisions concerning himself or

the community to which he belongs. This interest recommends an easy-to-understand and easy-to-access presentation of such up-to-date information. Rather than presenting raw data in an extensive fashion, new adapted ICT should be able to provide customizable information services that can be tailored to individual user groups, be it for reasons of content or be it for reasons of citizen's ease of access.

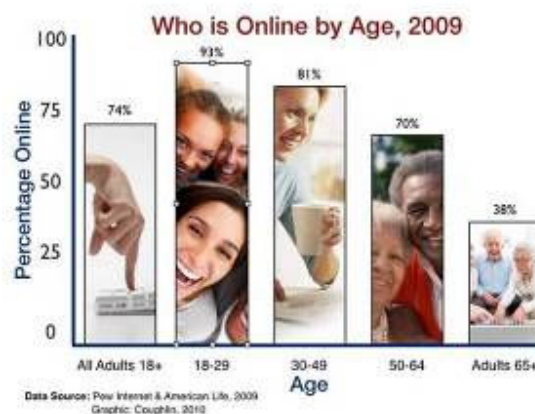


Fig. 1 The use of Internet by age

As participation in information technology becomes an increasingly important aspect of modern society, it is crucial to consider the accessibility of elder adults to this phenomenon. [9]

In an aging society, elderly should be seen not only as subject of "care" or "treatment," but the invaluable resources of knowledge and competence for our societies. Therefore, it is crucial to build, with the help of ICT, tools and environments from the perspective of usability and accessibility, so aging citizens might be able to increase their active participation in society by:

- prolonging working life, thus increasing productivity and reducing pension costs;
- having access to better healthcare, thus extending the quality of life and ultimately reducing health costs;
- enabling participation in society, thus diminishing isolation and loss of self-esteem;
- compensating for loss of function, thus supporting independence;
- facilitating people's involvement in social networks, thus strengthening family and community ties.

Learning plays a key role in aging societies as it can help to address many of the related challenges and opportunities, such as re-skilling and up-skilling in the knowledge-based information society. ICT has an important role to play in developing learning opportunities because it can provide more individualized learning, compensate for disabilities and provide new opportunities to access information and services. [10]

Seniors might struggle to use ICT because of:

- accessibility issues
- usability issues
- physical, cognitive, and emotional barriers
- lack of computer skills
- cost
- attitude

Current information tools are often not user-friendly for older people, and this makes it more difficult for them to use them for learning purposes or as a part of everyday activities. A practical problem for using information tools is often the user interface, which is rarely designed for older people. It may appear confusing if it has many elements, or the buttons and text may simply be too small for people with poor eyesight and who may have trouble using their hands with precision. The software menus are often complicated, and they may be in a foreign language.

All of this can make information tools difficult to use, and it becomes simply too much to think about the content expressed through the tool, at the same time as concentrating on using the tool itself. If using a tool makes the user feel frustrated and conscious of his/her own handicaps, it will not create a positive and motivating environment for learning.

With regard to individual, economic and social challenges by demographic trends, it is clearly stated that ICT can make key contributions to an independent living of elderly people. This refers to the following points in particular:

- ICT can reduce high expenses or health and care services
- ICT has the potential to provide individual solutions and hence to meet individual needs
- ICT has the potential to improve living standards
- ICT opens new business opportunities.

Technology has great potential for improving the quality of life for older people. e-health can improve the physical and emotional well-being of older people. Technology can also enable older people to remain connected to family and friends, especially with those who are distant. Technology can also help older people remain employed and maintain or upgrade their skills, or it can ease the transition to retirement.

New technology options vary from advanced biosensors with ICT incorporated, to other forms of body sensors, smart houses, and different kind of communication devices. Administrative tools for the health service system can also play a crucial role for making the services more effective with a higher quality.

It clearly appears that a major role in the link between aging people and ICT is played by the familiarity usage, objectives and meanings, covering issues of usability and accessibility, accountability and acceptability and of emotional experience and perceived value.

Benefits of ICT for the aging population are:

- Opens new avenues for patient-centered medicine
- Purchasing products and services: services are often cheaper and more conveniently available online.
- The empowerment of consumers and patients: is done by making the knowledge bases of medicine and health information accessible to consumers over the Internet
- Improving public service provision: the use of the internet and other digital services could help provide the aging population with better access to the government agencies they deal with.

Improve health and healthcare: e-health has the potential to increase the speed of access to health, increase patient satisfaction, provide a more appropriate point of delivery, reduce waiting times, improve the use of resources, help provide equality of availability and reduce medical errors.

#### IV. HEALTH EDUCATION INFORMATION SYSTEMS

Concerns about poor health information have stimulated efforts at many levels to design more integrated systems able to provide reliable information to inform decisions. Because of a more demanding citizen, IT and health specialists have been seeking ways to enhance the quality of information, to broaden its range, and to integrate information from a variety of sources to address more complex issues.

Healthy life style, as a concept, the characteristic features of everyday life of humans, including work, living, forms of use of leisure, needs moral and spiritual satisfaction, participation in political and public life, norms and rules of conduct, skills and strengthening skills in personal health, active participation in protecting and promoting health.[11]

Health Education Information Systems (HEIS) are changing the way health information is disseminated and managed, but implementation is a difficult task in which social and cultural issues must be addressed.

##### *A. Benefits of HEIS*

There are three main types of benefits that must arise from a Health Education Information System (HEIS): quality, access and efficiency. The impact on quality and access can be direct for citizens, or indirect, by enabling

healthcare professionals to improve the quality and efficiency of healthcare that they provide.

Among the factors that facilitate the benefits to quality are:

- more informed citizens
- health information designed around the citizen
- effectiveness.

More informed citizens implies those demanding to have direct access to data, information and knowledge about their conditions, diagnoses, treatment options and healthcare facilities, in order to enable them to take effective decisions about their health and lifestyles.

Health information designed around the citizen allows a better understanding of it for the non-professionals users and for healthcare specialists to have access to more complete and focused information. As a result, they can be more citizen-focused in their work.

Effectiveness of a HEIS is directly related to how well it satisfies its users' information needs. This effectiveness can be characterized by the system's readability, browsability, searchability, and finally, interactive assistance. Making the best decision on the most appropriate healthcare depends on information about the possible service options and their outcomes.

Is important that everyone regardless of socio-economic status, disabilities, and physical location have equal access to health information. ICT have come down in cost and have become very prevalent in almost all countries on the globe. For instance, mobile phones provide personal and wireless access to networks and to the Internet where available, while PDA's provide personal, portable computing and wireless access to the Internet. This liberation from control over access is a very important element in democratization of information access.

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The efficient health education and sharing of health information is indispensable for adopting a healthy way of living and also for the effective delivery of care. This is particularly important for aging people and those with chronic conditions, who often have several physicians. HEIS can ensure the timely and accurate collection and exchange of health information data that are likely to foster better care co-ordination, and the more efficient use of resources.

### *B. Challenges for Designing HEIS Customized for Aging Persons*

The first step in creating an accessible design is to get to know the users and their limitations. The limitations of aging persons are functional impairment due to age (e.g., limitations of visual perception, hand-motor function and dexterity, cognitive and perceptual abilities) and inexperience in the use of computers.

User-centered design, based on a fundamental understanding of user capabilities, needs, and preferences, will lead to improvements in performance. Thus, according to this principle, improving the health and quality of life of older people requires that the knowledge of aging be applied to the design of the new types of technology.

Managing health and medical data in electronic format for aging or elderly users brings significant challenges that have to be resolved. These include:

- how to identify the impairments of specific aging citizens in terms of access;
- how to cope with user's changing needs;
- how to facilitate information retrieval by users with different disabilities and objectives;
- how to store the large amount of complex and diverse data;
- how to balance data privacy concerns against clinical and research benefits of data availability;
- how to ensure that the captured data will effectively transfer into knowledge that facilitates healthcare decision making.

For a user-friendly HEIS we have to design multimodal user interfaces appropriate to the target population, and assistive systems that help users with navigation.

A HEIS designed for aging persons should provide context and orientation information, and ensure that presented information and data are clear and simple. The language and layout of the display have to be designed to be as simple as possible to ensure readability and comprehension by all users.

Icons should be simple, and concrete symbols should be designed to look like the object they represent and be distinguishable from others. Because of a general decline in acuity among elderly, the font sizes should be larger.

A context-sensitive help prevents the user from having to search through several items. Error messages should offer constructive advice and provide suggestions. The message should not only report the

occurrence of an error but also provide an explanation of its cause and offer possible solutions.

Aging affects the hearing function as well as the ability to concentrate on audio and text at the same time. Therefore, avoidance of sound effects is recommended unless a specific application requires their use.

Aging disturbs the reaction time to environmental stimulation and increases the time required to process displayed information. Therefore, features like pop-up windows and animated banners can be distracting and should be avoided.

Allowing the user easy control of font, color and contrast setting, as well as window resizing, scroll rate and zooming, is generally recommended.

Elderly users may experience changes in motor skills, including slower response times, declines in ability to maintain continuous movements, disruptions in coordination and balance, loss of flexibility, and greater variability in movement.[12] Thus, it may become a challenge to be steady with the mouse, or any other control device. Small targets and moving interface elements are known to be difficult for older people, and should best be avoided. [13]

Up till now, the designers for user-interfaces have focused primarily on the design requirements that make interactive applications usable for elderly users. Indeed, usability is indispensable; however, usability in itself is not a sufficient motivation to use an information system.

Many challenges remain and there are many obstacles yet to be overcome: issues of legality; semantic interoperability; homecare through telemedicine can increase health inequality, as some people are unable, cannot afford or are disinclined to use teleservices; e-health literacy - whether it is affordable for all; the need to build trust between the medical professionals and patients; the patients' right to choose the type of care they want; and how e-health and home care link in with other social care services.

Ideally, an optimal management of the health knowledge will motivate or mobilize citizens to use a specific HEIS.

The design and development of an appropriate HEIS should focus on providing an immediate benefit to those in search of health information or support, taking into consideration all the particularities imposed by aging.

### *C. Multidisciplinary System for the Efficient Management of the Anti-Aging Information – AgingNice*

The multidisciplinary complex system AgingNice belongs to the health education information systems with particularization in the anti-aging domain and

allows the sharing of the knowledge concerning the specific research and the promotion of the theoretical and practical information, both among the stakeholders from the medical area and at the person level. AgingNice 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.

To achieve a web application that aligns the latest European strategy in the field of anti-aging, the partnership of the project has identified specific priorities adapted to the Romanian environment and it has correlated them with the European ones, taking into account the particularities of the Information Society in Romania

The main objectives of AgingNice are:

- to concentrate the information in a relational database system in order to facilitate a fast access;
- to create educational and evaluating models for a person in order to outline his biological evolution and to identify the risk factors;
- to establish an environment concerning the multidisciplinary collaboration among the variety of medical and biological specialties involved by the domain;
- to increase the responsibility of the beneficiaries regarding their own state of health and their guidance for choosing a healthy way of living able to delay the aging;
- to offer the necessary information to the anti-aging practitioners for choosing a therapeutic protocol in order to prolong the longevity and to combat the anti-aging phenomenon;
- to organize an open informational space for the specialists and citizens interested in the prevention, improvement and treatment of aging causes;
- to provide reliable anti-aging knowledge, permanent updated with the help of an informatics tool that ensures a high degree of flexibility to changes and an effectiveness of the information management.

The practical results of AgingNice put into value the measurable, positive, sustainable economic performance of a health education informatics systems.

Estimated benefits of using AgingNice consist in a better quality of care, access to education, efficiency and time savings.



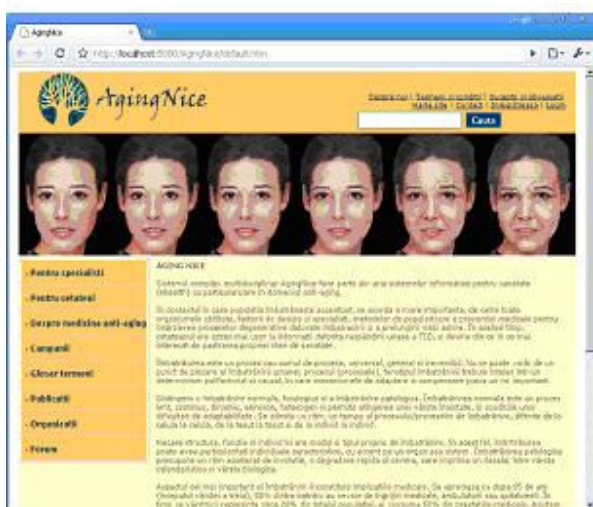


Fig. 2 The main page of AgingNice

The application with database available via Internet comprises an interconnected database system concerning (see Fig.2) anti-aging methods and strategies (see Fig. 3), clinical and laboratory investigations for aging preventing, anatomical modifications, educational models, self-evaluation tests, defining a personalized demeanour, tendencies in the anti-aging biomedicine, anti-aging campaigns and also applications for facilitating the dissemination of the therapeutic protocol, study cases and recent research among the specialists from la large range of medical domains.[14]

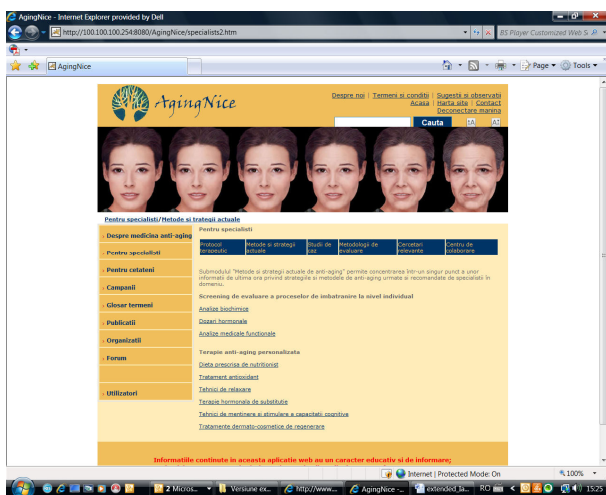


Fig. 3 “For Specialists” Module

AgingNice is at the final phase and in December 2010 it will be completely functional and implemented. Databases are filled by the health specialists from the project consortium and the application is tested both by professionals and average citizens.

The used architecture is a Client Server type organized in three tiers and it has a structure composed from elements that can function autonomously, and which architectural requirements were developed both different types of users.

Each module comprises several applications structured on levels for an optimal organization of information, according to the specific aimed objectives and it was qualitatively evaluated for its ability to be linked with the others and for its coverage.

The designing of the web pages is made taking into account the possibilities for coverage of the user, so that the quantity of information contained in a page not to overwhelm the visitor or to increase the time of loading. Also, the fragmentation of information has been designed in order to focus the user's attention on the main topics from the page and to help him to inspect gradually the presented subject.

The graphic user interface has an intuitive, ergonomic and friendly feature; it has a unique structure and it allows an easy access to the functions and applications of the system. Older users would benefit from this interface that is user friendly, simple and intuitive.

Security controls are a part of the integrated system design. Information technology security is used in order to control the access to the database and so to maintain a high quality of health information. The information providers must register with an authentication procedure and obtain a login ID and password to access the system.

The extensive using of AgingNice will have as consequences:

- the recognition of the timeliness and importance of the concept of anti-aging, of the multiple implications of implementing the strategies related to the individual and society as a whole,
- the understanding of the fact that, in terms of economic and financial, it is more effectively to prevent the degenerative diseases than to treat them,
- the improvement of the specialized knowledge and the professional skills for increasing the performances,
- the integration of the research, education and training activities with information technologies,
- the changing of the attitude towards the age management,
- the intensification of the collaboration among convergent specialties for considering thoroughly the anti-aging domain,
- the facilitation of the communication among the professionals and between those and the citizens.

## V. CONCLUSION

The world's population is aging at an accelerated rate. Aging is not an issue to be addressed through a single, confined approach or solution but rather a multi-faceted one presenting challenges

The coming wave of aging citizens are more educated, more demanding, and have experienced more technology throughout their lives than any previous generation.

They are viewed as consumers of information who can actively participate in achieving a healthy and active aging.

ICT can facilitate the involvement of citizens in becoming more self-responsible, but it can also become a barrier if they cannot easily and effectively use it to meet their needs.

Health Education Information Systems empower the citizen to become a stakeholder in his own health, who seeks greater participation in his healthcare and therefore greater access to his own health information.

The success of a HEIS depends on how well it serves the needs of the target population. Thus, crucial characteristics of the users, especially the aging ones, must be defined and addressed.

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