

## Assistive Technologies for Supporting Elderly People at Home: Telegerontology®

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**(Abstract)** The aging of the population worldwide implies an increase in the number of cognitive impairment associated diseases in the elderly. On the other hand, the number of informal caregivers is decreasing and consequently, we must guarantee the existence of enough social and health services for all the population in the immediate future. The new technologies allow us the development of more advanced instruments for gerontological intervention for both patients and caregivers. These

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new systems help to prevent the lack of home assistance, and thanks to the Internet connection, we avoid the disadvantages of the geographic dispersion of the population. In this article, we describe Telegerontology®, a new home attention tool for patients and caregivers. It integrates different functionalities related to physical, cognitive and medical intervention it works like a family support thanks to the professionals/patients communication, and integrates an advanced emergency system within a domotic environment. This system improves the traditional telecare since it, actually, has more sophisticated services and a higher quality of home support.

[Key words: Cognitive Stimulation, Elderly People, Home Support, Technology, Telegerontology, Telemedicine]

## Introduction

The ageing of the population in Spain is a palpable reality. The percentage of people aged 65 and over is estimated to reach 31.9% by 2050 (Statistics National Institute, 2010). Based on this prediction, we must work to prevent the shortage of social and health services in the future. In 2008, the average age for men and women stood at 81.2 years old. We know that age is a risk factor for developing cognitive impairment associated diseases (Hofman et al., 1991) so there will be a great number of dependents who will require specific treatments to prevent the advance of the age-related diseases and the disability.

The development of the new information and communication technologies (ICT) (Millán-Calenti, 2009), favours the potential development of new resources improving the traditional care services range. When technology joins gerontology, it gives rise to a new discipline called “gerontechnology.” The aim of this new discipline is to use technology to prevent, delay or compensate the age-related physical, cognitive and perceptive decline. Some of the benefits of using these new technologies for the elderly are

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(Millán-Calenti, 2002): help in facing personal and social isolation, avoid loneliness using different means of communication with any part of the world, encourage creativity, help to improve self-perception, stimulate their mind and therefore improve a healthier aging. All the above may help to reduce the advance of cognitive impairment.

To resolve the difficulty of access to the new technologies (Hernández-Encuentra, Pousada, & Gómez-Zúñiga, 2009), Telegerontology® has been developed based on the accessibility criteria that means it must ensure the availability for all people whether or not disabled. It is based on usability, which is a measure to determine the extent to which a product can be used by individuals and reach the proposed goals (Nielsen, 1993). Telegerontology® has also taken into account the principles of Universal Design (Berners-Lee & Fischetti, 1999; Follete, Mueller, & Mace, 1998) that specifies the 7 principles any design must meet: ① usable, ② flexible, ③ simple and intuitive, ④ providing the information required, ⑤ resistant to the errors, ⑥ requiring low physical effort, and ⑦ ergonomic.

In this article we will describe Telegerontology® which is a new system for home support addressed to both caregivers and patients that includes, on one hand, different services for physical and cognitive intervention and on the other hand, a constant supervision of professionals and an increased safety of the patient at home.

### **Telegerontology®**

Telegerontology® is a new device addressed to the attention of the elderly with or without memory impairments and dependent and/or autonomous. It is a device that results from the classical

Telecare but includes many more services. The objective of our tool is the prevention of the autonomy loss thanks to a multi-disciplinary intervention. It offers the following services: static contents, physical and cognitive rehabilitation therapies on demand and online, an stimulation and cognitive assessment program, a videoconference system which allows communication between the gerontological professional team and the users and caregivers, and an emergency system integrated into a domotic environment which allows to know the real status of the patient and the determination of his/her biomedical parameters.

The functioning of the system is based on an Internet connection, between the house of the user and a Call Centre (see Figure 1). For the reception and transmission of all data, the client must have an Internet connection at home and a specific gateway for the use of the system. The subject can interact with the service with a PC, a touch screen or a television. This last option has been developed to prevent architectural barriers to the access of older people to the new technologies because all seniors normally know how to use their own television. They must also have a mouse, a webcam and a microphone. If the older person has difficulty in the use of the conventional mouse due to bones and articulation damage, we have developed our own remote control device named Geropad® easier to grab and more simple in its commands.

The user has access to the application from home and through the gateway all data are sent by Internet to the Call centre where specialists in the field of Gerontology and in the use of the service, manage all data resulting from the interaction between the user and the application. The user who connects to Telegerontology® either from a PC or the own TV, will be able to interact with the 6 icons displayed on the main menu. Home screen services are the

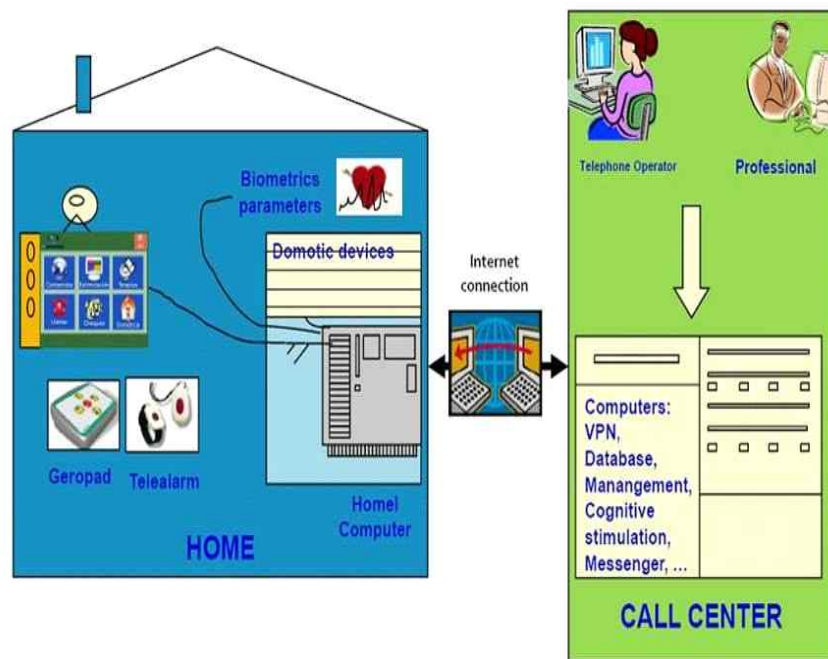


Figure 1 System Operation

following: Contents, Stimulation, Therapies, Call, Medical Check and Domotics.

The first icon named Contents includes different social and health presentations like nutrition, dementia symptoms, and present laws about dependence, mobilization of patients and/or the prevention of the eschars. Therefore, this service allows the carer to have access to a lot of contents related to the care and, to the patient, to have access to contents related to the prevention of pathologies.

Other service that is integrated in Telegerontology® is

Telecognitio®. Telecognitio® is a computerized tool for cognitive assessment and stimulation developed by a team of experts in gerontology. It is specific for the use of the elderly and is based on physiological and cognitive characteristics. It includes stimulation exercises covering different cognitive areas such as attention, perception, abstract thinking, orientation, memory, language, calculation and praxias. It is a personalized application because each user performs the cognitive training based on his/her personal needs.

There are 4 levels of difficulty based on the user's cognitive impairment; which are the following:

- 1) Elderly without memory problems of memory.
- 2) Age Associated Memory Impairment (AAMI) (Soriano et al., 2007): This diagnostic picture is associated with subjective memory losses in people older than 50 years, subjective complaints of memory losses in the daily living, lower performance on different tests of memory with a result of a point below the average established for young and adults, preservation of intellectual functions and absence of diagnosis of dementia.
- 3) Mild Cognitive Impairment (MCI) (Bozoki et al., 2001; Petersen et al., 2001; Winbland et al., 2004): The diagnostic criteria established for the mild cognitive impairment are the following: subjective memory complaints reported by the patient, family or detected by the specialist through an interview or test of mental state normal activities of daily living normal global cognitive function objective alteration of memory or other area of cognitive function evidenced by scores higher than 1.5 deviations below the average of the age group and with no evidence of dementia.
- 4) Dementia (American Psychiatric Association, 2000): The dementia is defined as "reduction of multiple cognitive deficits (including memory impairment, sufficient to interfere in the care,

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work or social relationships.”

One of the novelties included in Telecognitio®, is the presence of a cognitive evaluation system integrated into the training activities that allows the cognitive assessment of the user and a continuous monitoring by professionals. All the data obtained both from the stimulation sessions and the evaluation are sent on-line to the Call Centre from where the professionals study the user's cognitive status in a monitored 24 hours system. The first results obtained regarding the efficacy of the cognitive stimulation show improvements in attention, concentration, and short and long term memory.

Others services included in Telegerontology® are the therapies. In this section, the user can access two types of services: videos on-demand and online videos. Videos on-demand are gerontology related videos that both the user and the caregiver can enjoy at home, whenever they want to. These videos are recorded and edited by geriatric professionals like medical doctors, nurses, psychologists, occupational therapists, physiotherapists, and speech therapists. This kind of therapies includetraining videos focused on public health issues as prevention of ageing factors, how to perform the measurement of blood pressure, basic notions on emergencies and/or legal incapacitation. There are videos related to mental stimulation such as geography, recognition of facial expressions, perception, verbal fluency, videos with the objective of training memory in general and relaxation sessions. The field of physical therapies include recordings about stretches, abdominal exercises for the neck, exercises for the spine and hip and balance exercises, among others.

Therefore, videos on-demand are videos about physical and cognitive intervention or therapies, presented in a funny and entertaining way, which the user can perform at home at any time

and with the desired frequency. Other type of therapies is the on-line therapies. With this service, the user can perform activities at the same time they are being carried out by users of the Gerontological Complex La Milagrosa in A Coruña. This is possible thanks to the domotic environment which, using the web cams, allow the dissemination of the activities on-line.

Telegerontology® includes a video conference service which allows, a 24-hour communication between the Call centre and the users at home and also to fix appointments with all the professionals including medical doctors, nurses, psychologists, speech therapists, occupational therapists and physiotherapists. This service is intended for both the patient and the caregiver. The user, by clicking the icon “Call,” will automatically open a screen with all professionals available and may establish a videoconference with them, as often as desired within the established timetable. This service allows both the patient and the caregiver to have a member of the multidisciplinary gerontology team available 24 hours a day.

Another service offered by Telegerontology® is the emergency alarm. The user carries a bracelet or a pendant and in case of emergency, by pressing the alarm button, it would trigger an alerting system in the call-centre. The centre is in constant monitoring 24 hours a day with expert professionals in gerontology and in emergencies. The alarm signal appears in the Call centre by means of a visual and acoustic signal. Automatically, the medical history of the patient is opened with information about the primary carers, the exact address and the previous call registers to know the number of emergencies calls made by that user, the reasons, frequency and urgency levels.

This system is different from others devices in the market because in our system, the alarm signal implies the start of a

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videoconference with the user and through a network of web cams installed at home, we can know exactly the real state of the patient. Thanks to the visual and auditory information, we receive the required information to catalogue the level of the emergency.

Another service that is included in Telegerontology® is the determination of biomedical parameters. The gateway incorporates a sphygmomanometer, a thermometer and a pulse oximetre. The system is able to inflate and deflate the different devices automatically, and therefore the user can obtain the following vital signs at home: both systolic and diastolic blood pressure, blood oxygen saturation or pulse, temperature and heart rate. For the calibration of each system, we do a prior appraisal of the vital signs of the patient to know the basal level. Any measure that separates from the normal user range value will open the alarm detection in the Call Centre and an alert to the professional of reference.

Thanks to the Internet connection, the system is capable of sending these data to the call-centre and the professional of reference. Furthermore, with this service, the user will not have to go to the centre for the measurement and professionals will get many measurements along the time, allowing us to have a better track of the biomedical parameters of the subject.

### **Discussion**

The devices included in the Telegerontology® system can be found in the market today, but as independent tools. Telegerontology® joins different services with different characteristics from the present services. It has been specifically developed for older people with or without memory problems and taking into account the characteristics of the aging. The interface allows the

autonomy in the use by the elder person without external aid. The system can be used in a computer display like a touch screen, which decreases the difficulty to access to the service (Murata & Iwase, 2005) and we can also delete architectural barriers using the services on the TV.

The system is developed for physical, cognitive and affective intervention and for both users and family members. The service includes online videos, videos on-demand and it is integrated within the professionals' network. All the aforementioned turn it into an essential intervention tool and currently, there is no other product integrating all these functions.

As we know, the new computerized systems for the cognitive stimulation are effective for the prevention and the decrease of the cognitive decline (Franco & Bueno, 2002). In the market nowadays, there are different computerized tools for the cognitive stimulation and assessment but none of them have been developed specifically for elderly people only, have integrated stimulation and assessment, have an on-line evaluation associated to the Mini-Mental State Examination (MMSE), train and assess 8 cognitive functions and have a 24 hours supervision by the psychologists thanks to the connection between the user's home and the Call centre.

For example, the cognitive stimulation program known as Grador (Franco et al., 2000), has been developed for brain damage, intellectual disability and mental pathologies. The cognitive areas it includes are the attention, the perception, the memory and the calculus. The Smartbrain (<http://www.smarbrain.net>) is focused on cognitive impairment but not related to any syndrome. It trains the attention, the memory, the language, the orientation, the calculus and the gnosias. The THINKable (Giaquinto & Fiori, 1992) has been developed for memory impairment independently of the diagnostic. The Rehacom (Friedl-Francesconi & Binder, 1996) has

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been developed for cognitive impairment and brain damage and it works the visual attention, the perception speed and the execution time.

As regards cognitive assessment programs (Katherine et al., 2008), only the CANS-MCI, CODGRAS-D, CogState and the MCIS are specific for elderly people and only the CANS-MCI (Tornatore et al., 2005) showed a significant correlation between different tests for the validation of the program. Telecognitio® includes a measurement of the patient cognitive state thanks to the MMSE computerized test.

Videoconferencing is a novel system allowing communication among all the gerontological multidisciplinary team and the user and the caregiver. Videoconferencing system also allows dissemination activities carried out in the Gerontological Centre “La Milagrosa” of A Coruña. The users can perform the activity at home so we avoid the institutionalization. Another innovation included in the system is the presence of webcams at the patient’s home providing professionals with the necessary information about the emergency.

When the determination of biomedical parameters is available at home, patients are more satisfied (Chae et al., 2001). Our service is similar to telemedicine but in the case of Telegerontology®, the system comes integrated with many more features and services and, in addition, it sends the measurement data to the control centre through an online system. Telegerontology® is therefore a novel system that includes different services for the family and for the user, and it is well positioned as one of the most comprehensive home care products on the market today due to the different services included and the price reduction compared to the traditional systems.

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