Why ICT are interesting for Frailty

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Due to the increasing average lifespan, the occurrence of neurodegenerative disorders such as dementia has risen by unprecedented levels, thus engendering high socio-economic costs. Another concept that has recently attracted the attention of researchers and clinicians is that of frailty, defined as a multidimensional geriatric syndrome characterized by increased vulnerability to stressors as a result of reduced capacity of different physiological systems. Traditionally, the concept of frailty has focused principally on the physical domain. Recent work has started to study more deeply the cognitive impairment due to physical frailty, and lead to the definition of cognitive frailty, defined by the simultaneous presence of both physical frailty and cognitive impairment without the presence of a concomitant neurological disease [1]. Cognitive frailty is viewed as a potential precursor of neurodegenerative processes with good potential for reversibility, and thus is the ideal target of early intervention. In addition psychological aspects are an important factor of frailty even if today less explored.

In the last decades there has been a growing interest in employing Information and Communication Technologies (ICT) to help assess and evaluate patients' functional impairments, as well as to help and support patients in everyday activities. Concerning clinical assessment, ICT play an important role allowing the development of new methods to evaluate more objectively behavioral and functional deficits [2]. This is important for clinical activity, as well as for research purposes. Beyond being important for assessment, ICT can also play a key role in the patients' treatment, stimulation, and rehabilitation. This is the underlying idea for the development of Serious Games (SG).
The purpose of this article is to illustrate the interest of ICT in the field of frailty in three domains, assessment, data basis and intervention.

Assessment using ICT

ICT devices enable the patients' performances and actions to be captured in real time and real life situations and to be accurately evaluated. This is particularly important for domains such as cognition, motricity, eating and activities of daily living.

To achieve these goals it is important to use simple devices with easy and understandable scores, with as added value, in comparison to the present tools, ecological validity, reliability and limitation of the interjudge variability.

The general recommendations [3] concerning the use of ICT are listed in table 1. The different types of sensors need to be simple and easy to use to avoid a population selection based on their ability to understand device utilization. Various potential sensors exist, and therefore, the choice should be done accordingly to the assessment conditions (in the patient daily life, in a clinical consultation setting, in Nursing home, at home) and to population characteristics. In the case of frailty multiple domains need to be assessed. Technical progress may allow the implementation of one device with multiple sensors (eg actigraphy, body temperature, audio recording).

Concerning the audio and video recording devices, it is particularly important to employ automatic recording and analysis of the data. This is crucial when long term monitoring is required, such as for the assessment of behavioral disturbances.

Tables 1: Sensors characteristics according to recommendations and types:

Characteristics

- Sensitive to change in the type and intensity of patient activity
- Sensor easy to install / wear
- Immediate output for the clinician
- Self explanatory (easy explanation) for the user
- Understandable feed back information for the clinician
- Easy maintenance of the equipment

Sensors types:

- Accelerometry / Actigraphy
- Video 2&3D – ambient
- Video 2&3D – wearable
- Speech tracking
- Multi modal sensors
- Infra-red sensors
- Tracking technologies (Global Positioning System)
- Smart Phone and Tablet
- Serious game

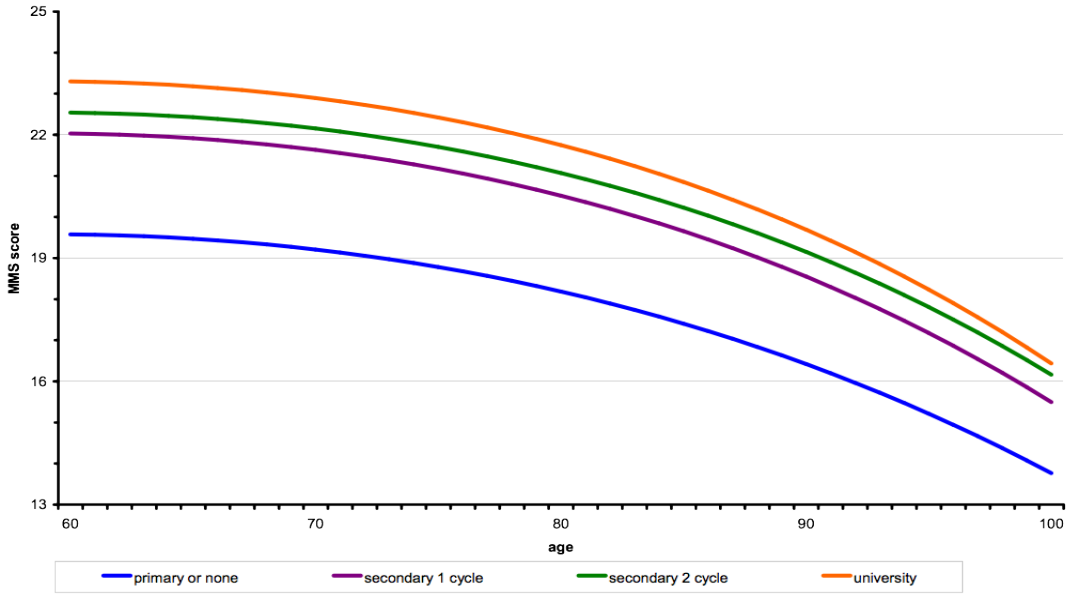
Data basis for frailty

All the instrument developed by the Gerontopole in order to implement screening procedures for identifying frail elders may be developed in a electronic version. As example an electronic file is already at the disposition of clinician (http://cmrr-nice.fr/cobtest/dmf/ or http://www.innovation-alzheimer.fr/accueil/)

Such instrument can obviously be modified according to the professional's request.

The next step is to transfers these data in a national data basis aiming to help clinicians in daily practice and to provide information for research. For this the model is the French National Alzheimer database (BNA).
In 2008 the third French National Plan for “Alzheimer and Related Disorders” 2008-2012 was launched, having the following objectives: to strengthen research on Alzheimer’s disease and related disorders, to promote earlier diagnosis and to improve both patient management and support for carers. One specific part of this plan resulted in the creation, in 2009, of the French National Alzheimer Database (BNA), aiming to provide epidemiological data as well as activity indicators for all French memory centres. The information collected in the BNA consists of a limited set of data concerning demographic, diagnostic and clinical details, defined by national consensus. The number of variables is restricted to facilitate and enhance the participation in this national database. Participants are the French memory units (memory centres and the memory resource and research centres) and independent specialists.
Today the French National Alzheimer Database provides both for policy makers and for participating centres on-going information on amongst others Alzheimer disease [4]. Analyses of the data can be used to prepare activity reports but can also lead to research hypotheses and improvements in patient care. Using the BNA, correlations can be explored between Alzheimer Disease, other related disorders or the MMSE score (figure 1) on the one side and demographic, social or medical variables on the other side.

Figure 1: *Patient with Alzheimer’s disease and related disorders (n = 39 451 patients): MMSE score at the time of first diagnosis according to age and educational level* [5]



Intervention using ICT

We need to remember that the final target of the frailty assessment is to help to the development of preventive strategies. Serious game (SG) is an example of tools that can be used in order to enhance user's aptitudes or cognitive/physical functions.
A SG is a solution that combines entertainment and motivation to facilitate learning, training and social bonding in the context of an activity.
The elderly population (above 50 years) represents now a considerable portion of digital gamers, which is predicted to increase. For this reason, SG may represent a low-barrier,

motivating, sustainable and relatively cheap method to improve, or at least delay the onset of impairments in selected social, sensory-motor and emotional functions.
Table 2 proposes a SWOT analysis of the interest of SG for frailty [6].

Table 2: Summary of a SWOT analysis of the use of SG

STRENGHTS - Interface adapted to the user - Gaming factors to enhance motivation, positive mood and improve assessment - Implicit learning - Independent practice and self-assessment - Safe testing and training environment - Promote social bonding - Enhanced ecological validity - Control of stimulus delivery - Cuing stimuli for error-free learning – Performance analysis in real time - Real-time feedback delivery - Promote learning processes - Low-cost, duplicable environments	WEAKNESSES - Interface challenges - Non-naturalistic interactions - Wires and displays - Immature engineering process - Expensive equipment - Poor platform compatibility - Software difficult to use - Lack of generalization - Addiction - Side effects
OPPORTUNITIES - Emerging advances in technology - Real time data analysis - Gaming industry drivers - Intuitive appeal to the public - New professions - Closeness between scientific, technical and clinical communities - SG as research instruments - Telerehabilitation - Big market	THREATS - Ethical challenges - Lack of assessment methodology - Lack of regulation - Lack of business model - Too few cost/benefit proofs - Technological vs. clinical tool - Aftereffects - The perception that the technological tools will eliminate the need for the clinician - Unrealistic expectations - Academic and professional acceptance - Technophobia

Even if the overestimated expectations, frequently presented by the media, are far from being achieved. The SWOT analysis showed that SG can be considered as useful tools for professionals involved in the care of patients suffering from AD and dementia-related disorders and frailty.
The field will need to face a number of challenges, which will benefit from the multidisciplinary collaboration between engineers, researchers, clinicians, healthcare professionals, patients and family caregivers.

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