

# Chapter 28

## Empowering Patients in Self-Management of Parkinson's Disease Through Cooperative ICT Systems

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### ABSTRACT

*The objective of this chapter is to demonstrate the technical feasibility and medical effectiveness of personalised services and care programmes for Parkinson's disease, based on the combination of mHealth applications, cooperative ICTs, cloud technologies and wearable integrated devices, which empower patients to manage their health and disease in cooperation with their formal and informal caregivers, and with professional medical staff across different care settings, such as hospital and home. The presented service revolves around the use of two wearable inertial sensors, i.e. SensFoot and SensHand, for measuring foot and hand performance in the MDS-UPDRS III motor exercises. The devices were tested in medical settings with eight patients, eight hyposmic subjects and eight healthy controls, and the results demonstrated that this approach allows quantitative metrics for objective evaluation to be measured, in order to identify pre-motor/pre-clinical diagnosis and to provide a complete service of tele-health with remote control provided by cloud technologies.*

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## INTRODUCTION

The rapidly aging population due to increased life expectancy and a decline in fertility contribute to an older world where the number of persons aged 60 or over is expected to grow from 841 million in 2012 to 2 billion in 2050 (United Nations Population Fund [UNFPA] and HelpAge International, 2012). This demographic context is inducing both international and local communities to promote novel actions for guaranteeing that people age well and to investigate new strategies which are both economically and socially sustainable (Aquilano et al., 2012).

In this scenario, the active engagement of the elderly in the co-management of their health and well-being as well as in the treatment of their diseases, and the close cooperation with both clinicians and formal/informal caregivers, are key points in the development of novel and well-structured care paradigms.

New personalised services and care programmes able to empower patients in the management and treatment of their diseases in each phase according to their progress and to the level of their co-morbidities are needed.

For this purpose, and considering the growing interest of high-tech companies such as Apple, Samsung and LG in the healthcare industry, Information and Communication Technologies (ICTs) systems are investigated. The technological solutions have to be feasible, scientifically/technically effective, acceptable and sustainable, considering that the current healthcare system has to be improved both in terms of services provided and cost-effectiveness. User-centred design techniques are mandatory in order to develop innovative technological solutions able to satisfy users' requirements and to provide efficient support to every stakeholder involved in the management of the disease.

Integration of mobile health (mHealth) applications, cooperative ICTs, cloud technologies and wearable devices can represent an optimal solution to empower patients to pursue healthy lifestyles and to manage their health and disease, in cooperation with their caregivers and professional medical staff, across different care settings, developing a health system aimed toward the home environment through the implementation of a remote control system and telemedicine service.

The overall aim of this chapter is to propose an innovative system able to support the neurologist for an objective, non-invasive and sustainable Parkinson's disease (PD) diagnosis, compared to the current practices. For this purpose a novel wearable ICT-based solution, equipped with inertial sensors, able to finely and objectively measure the motor performances both of patients with Parkinson's disease and subjects that show risk factors and related co-morbidities, is proposed. The technological instrumentation adopted, through its physical and measurement properties, is able to support the medical staff in diagnosis, overcoming the subjectivity and variability that currently affect the identification and assessment of the pathology, on the basis of typical semi-quantitative clinical scales.

Using the proposed system, the neurologist will be able to:

- Identify the early worsening in motion skills of subjects in a preclinical phase of the disease, anticipating the diagnosis and pharmacological therapy, so as to delay the onset of the pathology, to slow down its development and eventually to reduce the number of patients in advanced stages of Parkinson's;
- Accurately quantify the disease stage in patients with Parkinson's disease and to evaluate the response to pharmacological therapies, allowing a personalized monitoring and care service.

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