Reabilitar@mente

Effectiveness of cognitive rehabilitation programs for hospitalized elderly people. The aim is implementing cognitive rehabilitation programs to improve orientation, memory, and functional independence concomitant with a complementing rehabilitation nursing interventions in the area of functionality.

Decree-Law no. 30/2011 of 2 March created the Centro Hospitalar e Universitário de Coimbra, E.P.E., a Public Institution. The Centro Hospitalar e Universitário de Coimbra, E.P.E. (CHUC) comprises the following hospitals: Hospitais da Universidade de Coimbra (HUC), Hospital Geral (HG), Hospital Pediátrico (HP), Maternidade Bissaya Barreto (MBB), Maternidade Daniel de Matos (MDD) and Hospital Sobral Cid (HSC).

CHUC's mission is to provide high quality, differentiated healthcare in a context of training, teaching, research, scientific knowledge, and innovation, and to be a national and international benchmark in areas considered to be centres of excellence.

According to its vision, CHUC is an open organisation, made up of a network of hospital units, services and technologies structured and integrated to provide society with humanised, complete, close, reliable, and transparent care with a positive impact on the community, guaranteeing efficiency and overall sustainability in the medium and long term.

It has a workforce of more than 8,000, around 1,700 acute beds, and in the first half of 2023 there were 1,3687 emergency appointments, 2,6745 patients discharged, 2,597 patients operated on, and 62,353 Day Hospital sessions.

In any hospital, the Internal Medicine Service is considered a fundamental valence and the "pillar" of the organisation, as it integrates knowledge built up and dispersed by the different specialties or subspecialties that were born from it.

Internal Medicine is a core speciality in the health system, it is versatile and is defined as a speciality that is more about patients than diseases.

Internal Medicine intervenes at all levels of health and disease, namely:

- Health promotion
- Disease prevention
- Diagnosis
- Therapy
- Follow-up
- Coordination with other hospital specialities and primary care

Challenge description

At Centro Hospitalar e Universitário de Coimbra, 70% of medical admissions and 73% of medical hospital days belong to patients over 65. However, it has been recognised that the hospital response is not adequate for this population, with long stays in hospital and progressive functional and cognitive decline.

Associated with the aging process are cognitive changes that cause disabilities and limitations, such as reduced mobility, decision-making, memory loss, difficulty in managing daily routines, among others.

Maintaining cognitive health is a fundamental premise for preventing cognitive impairment and delaying the onset of dementia, dependency, and the person's (in)ability to take care of themselves. Cognitive rehabilitation is considered to be a therapeutic process that aims to systematically recover, compensate, and promote neurocognitive skills, based on the assumption of the brain's plastic capacity. It is in this context that the reciprocal relationship between the person and the environment is established, and therefore the possibility of the application of a Cognitive Rehabilitation Program having an impact on brain plasticity.

On the other hand, the interest in the relationship between the specific needs of the elderly and the usefulness of technologies in meeting them is evident in the growing number of studies on the use and acceptance of technologies by this segment of the population.

Currently, some studies have shown that cognitive stimulation combined with new technologies causes positive changes in the memory of the elderly, as well as instructing them in useful technological skills to facilitate daily activities and can even bring social benefits.

In this context, and given the challenges that aging faces today, there is a need to design and implement a cognitive rehabilitation program in a hospital setting in partnership with new technologies, particularly in internal medicine services.

It seems also important to be possible to use these technologies after discharge and monitor the effects of a cognitive rehabilitation program at a cognitive level, as well as the repercussions at a functional level as a contribution to improving the person's quality of life.

Challenge main objectives

There is evidence that one of the predictors of functional decline during hospitalization is cognitive impairment. With this in mind, the aim is to develop a rehabilitation program that includes exercises in the areas of cognitive rehabilitation, on topics related to each person's personal tastes, as well as some occupational activities from their current and past life.

Solution functional requirements

Compulsory functional requirements

The application of cognitive rehabilitation, using new technologies, should consider:

- A low degree of difficulty in interpretation, given that the vast majority of patients have a low level of education, and can't read or write.
- A low level of ICT/digital literacy
- Visual impairment
- Difficulties to hear.
- Mobility limitations, namely the inability to get out of bed.

Therefore, the solution shall:

- Provide engaging content for cognitive rehabilitation considering the above-described characteristics of the targeted population.
- Provide feedback on patients' performance, so that the patients can self-assess and improve.
- Include an accessible and friendly UX/UI adapted to the characteristics of the targeted population such as (but not limited to) prioritizing images over texts, possibility to increase font sizes, audible support for people with hearing loss, among others.
- The solution shall be adapted to patients' held devices like smartphones, tablets, laptops and/or smartTVs.

Desirable functional requirements

The solution could be adapted to the socio-economic and socio-cultural level of the patient, considering factors such as jobs and hobbies.

The solution could combine both physical and cognitive rehabilitation.

The solution could be adapted for later use of the patient at home, after hospitalisation.

It would be desirable to combine movement and reasoning in the same exercises.

Possibility of monitoring each patient results over time.

Pilot scope

The pilot will be developed in a total period of 12 months, including design, validation, testing and measuring of the impact of the co-created solution.

It will be expected to test the solution for 6 months.

The healthcare professional's teams will be composed by nurses (leading by rehabilitation nurses).

The target population for this project is all elderly people admitted to internal medicine wards with altered functional independence, orientation, and memory. The sample will be selected according to the voluntary participation.

End-user type	Role	Number
Nurses (rehabilitation)	Provide requirements, use, and validate the solution.	3
Patients	Validate the solution	50

Table 1. Targeted users

Language

- The language will be in Portuguese, simple language, using images, symbols, and sounds.

Pilot set-up conditions

The pilot setup conditions correspond to the objectives of exploring and testing a program for the cognitive rehabilitation of the hospitalized elderly people.

The cognitive rehabilitation programme will consist of helping people to improve the performance of their activities of daily living, providing autonomy and independence.

It should incorporate specific exercises to develop the basic areas of mental function: attention, language, memory, visual-spatial ability, and association of ideas.

The exercises should be applied through any medium capable of representing everyday situations in which the person is encouraged to concentrate, interact, reason, and make decisions, understand speech, and express feelings and thoughts.

Ethical, legal, or regulatory

All CHUC employees, as well as the general public, including companies that collaborate with CHUC, are governed by the Privacy and Data Protection Policy (Publication of 11.08.2022, Board

of Directors), which explains the terms under which CHUC processes the personal data of its users, as well as the rights they may exercise, in accordance with the provisions of Regulation (EU) 2016/679 of the European Parliament and of the Council - General Data Protection Regulation (GDPR) - and other applicable national legislation on privacy and data protection.

In addition to Privacy and Data Protection, all CHUC managers and employees must consider the Code of Ethical Conduct (Publication of 22.09.2022, Board of Directors.

The pilot should have the approval of the Ethics Committee of the hospital and the inform consent of the patient or caregiver.

Technological

It must be usable on a tablet or smartTV. In the case of combining movement and image, specific software will have to be install/developed for this, and possibly access to cameras.

Expected impact and KPIs

With the implementation of cognitive rehabilitation programmes for hospitalised patients over 65 years of age, the expected impact is to:

- Reduce the cognitive decline of the elderly during hospitalisation using innovative technologies in cognitive stimulation.
- Improve the functionality of hospitalised elderly people.
- Improve the quality of life and patient experience/satisfaction for the over-65s.

To measure the results, we can use:

- Maintain or increase the FIM [1] score.
- Maintain or increase the MoCA [2] score.
- Maintain or increase the Quality of Life [3] score.
- Levels of satisfaction with care >5 (1-10).

Business opportunity

Market size

CHUC's Internal Medicine Service preferably serves the population of the catchment area assigned to it by the hospital referral networks (Centre Region of the country).

The solution developed as part of the pilot could be replicated in the other internal medicine departments (a total of six more). In addition, we believe it would be useful to implement it in other contexts, particularly in other medical speciality services. It will also have applicability in other contexts, given that the rate of elderly people admitted to the institution is quite substantial.

[1] FIM (Functional Independence Measure). Aims to diagnose the degree of functional capacity/disability of adults and the elderly, assessing the person's performance and the need for care required to carry out a series of motor and cognitive tasks of daily living. The maximum total is 126 points and indicates total independence and the minimum is 18 points and indicates total dependence.

[2] MoCA (Montreal Cognitive Assessment). Is a brief screening tool for mild cognitive impairment. This instrument assesses different cognitive domains: executive function; visual-3spatial ability; memory; attention, concentration and working memory; language; and temporal and spatial orientation. The maximum score is 30 (points).

[3] SF-36 v2 (MOS Short Form Health Survey 36 Item v2. Measuring and assessing the health status of populations and individuals with or without disease; monitoring patients with multiple conditions, comparing patients with different conditions and comparing the health status of patients with that of the general population.

Adoption plans

The department of internal medicine and medical specialities is the largest in the hospital. And in general, the elderly population fills a large number of hospital beds.

If the pilot is successful, CHUC intends to adopt the solution, by shared ownership the solution co-created and procure its maintenance.

Leading SME

GENERAL INFORMATION	
NAME OF THE SME	NEUROINOVA, Lda
DESCRIPTION OF THE SME	Neuroinova is a SME dedicated to R&D of technologies in the field of cognitive diagnosis, monitoring and rehabilitation. It is specialised in the field of cognitive health, developing innovative services based on the implementation of technologies on common clinical processes. The systems and technological products that it develops are focused on two fundamental aspects: 1) in the increase of the ability and quality of work of highly specialised health professionals (e.g. neuropsychologists, physical therapists, occupational therapists) and 2) improving patient access to early diagnosis and supervised interventions in the area of cognition and consequently their participation in the therapeutic path. The company currently assures the whole chain of technical-scientific development and marketing of technology-based medical devices COGWEB® (Web-based cognitive training) and Brain on Track® (Cognitive monitoring system). These products are directly marketed to the end customer (full-stack services) or through licensing to institutions or individuals after a specific training process.
WEBSITE URL	www.neuroinova.com/

Table 2. Leading SME general information

Solution proposed:

Cognitive Vitality Training 2.0: CogniViTra 2.0

The existing COGWEB solution will be enhanced to incorporate a range of new functionalities aimed at facilitating functional rehabilitation and adaptation for patients during hospitalization and discharge - CogniViTra2.0. This upgraded system will specifically target individuals facing cognitive health risks even after leaving the hospital. The proposed cognitive 5 training programme includes the possibility of prescription of simple motor tasks, and it is adapted to the needs and tastes of each patient. This solution will have a series of additional features to meet the needs of a population in-hospital recovery and can be subsequently used at home, within a perspective of continuity of care and prevention of dementia and cognitive deficits. To increase adherence and make the system more meaningful for users, cognitive rehabilitation tasks will focus on topics related to each person's personal preferences, as well as some occupational activities from their current and past life.

The COGWEB® (a cognitive training program previously developed by our team) is composed of several exercises, with different levels, aimed at training different cognitive functions, such as attention, memory, language, executive functions, among others, that the professional uses to create training plans adapted to the needs and characteristics of each patient. As it is an online platform, it is available from any computer or tablet with internet access, without the need to install any software.

CogniViTra2.0 is based on products and services that the team has been successfully implementing on the market for many years, representing an evolution of those products and services to meet the growing needs of patients and healthcare professionals. The characteristics of our current solution, together with the features we propose to develop within this project, enables:

- Flexible and personalized creation of intervention plans tailored to the user's characteristics, adjusting the type of cognitive training exercises, their degree of difficulty and the type of content.
- Deliver engaging content tailored for cognitive rehabilitation, considering the unique characteristics of the targeted population.
- To define the type of response (mouse, touch, or motor) to cognitive exercises.
- Prescription of simple motor tasks.
- Cognitive and physical training tasks to be carried out both during hospitalization and after discharge, at home.
- It is adapted for use by people with low levels of education and digital literacy.
- It remains usable post-discharge and facilitates ongoing monitoring.
- Continuous monitoring by accessing patient performance records and graphs.

If widely adopted, the described solution could have a significant impact on the Centro Hospitalar e Universitário de Coimbra response promoting continuity of care and intervening in the prevention of dementia and cognitive deficits of the population. CogniViTra2.0 aims to extend the capacity of healthcare professionals to support people in need of cognitive stimulation by providing a solution that allows them to follow-up more people simultaneously. It aims to address the demand from patients for increased session hours, surpassing the limitations imposed by the availability of care resources, including human and physical infrastructures. By doing so, it contributes to significantly reducing the delivery costs of healthcare services. Furthermore, it has demonstrated the potential to enhance professional productivity by up to 50%. Interactions with care professionals have indicated that CogniViTra2.0 enables effective monitoring and simultaneous care for more patients, suggesting a cost ratio below 1. Additionally, the solution's adaptability to different contexts ensures its effectiveness across diverse patient populations, making it a valuable asset for the hospital striving to provide comprehensive and patient-centered care. Neuroinova complies with the standards defined by the GDPR and ISO 13485, so all security and confidentiality issues are assured.

Work to be done by the leading SME

CogniViTra 2.0 is structured into four distinct Work Packages (WPs), each with specific objectives and tasks distributed across the project's 12-month timeline. The leading SME will develop the following tasks within each WP:

- **WP1**, "Project Management & Coordination," focuses on ensuring seamless collaboration, and the tasks to be done are related to efficient project management, risk mitigation, financial oversight, and quality control.
- **WP2**, "Prototype development" is dedicated to developing and integrating the new features of the solution while optimizing the current features. This task aims to develop the CogniViTra 2.0 prototype to be tested in a laboratory environment and then in a clinical setting. Initially, the task will focus on developing non-functional prototypes of

the final service that will be validated by target groups to consolidate the functionalities to be implemented; in particular, those related to implicit and explicit interaction mechanisms. After conceptual validation, the necessary applications will be implemented. This includes the definition of requirements for the solution for cognitive training, the development and integration and the product testing and re-engineering.

- **WP3**, "Pilot Deployment and Validation" encompasses tasks such as ethical approval, privacy protection plan, user recruitment, usability tests and pilot deployment; In this WP it will be initiate the ethical approval process, that comprehends preparing and submitting all necessary documentation for pilot deployment, as well as implementing an all-encompassing user recruitment strategy designed to target participants who meet the inclusion and exclusion criteria outlined for pilot studies. This WP also includes the deployment of the pilot study, using the proposed solution, for a total of 50 users.
- **WP4**, "Dissemination, Business, and Exploitation Strategy" is committed to developing a robust dissemination plan, business strategy, and exploitation roadmap to ensure the project's research results reach a wide audience and pave the way for successful commercialization and sustainability.

Follower SME

Scope of work performed by the follower SME

The specific tasks and activities allocated to complement the development of the innovative solution proposed are focused in technical and clinical features. As stated before, it is of great importance that a health solution is accessible, intuitively usable and adapted to the target population, namely elderly individuals with limited levels of digital literacy that might also have cognitive deficits. Usability and user experience will be considered in the co-creation process and will be applied using different methodologies, and we believe it would be valuable to involve a partner with experience in designing user interfaces for digital health platforms, to develop tasks aimed at optimizing and improving CogniViTra2.0 interfaces.

The tasks to be carried out by the Follower SME would be mainly focused on:

- Visual design, to create adapted and aesthetic interfaces; Interaction design, to ensure optimized interactions with interface elements, including navigation and feedback mechanisms.
- Accessibility, to guarantee that the interfaces are adapted to be used by people with low digital literacy and with disabilities, including requirements about colour contrast, fonts.
- Responsive design, to assure that the interfaces adapt to different types of screens providing a consistent user experience across platforms.
- Usability testing, participating in the evaluation of the effectiveness and usability of the interface design.
- Documentation, namely creating design specifications, style guides and other relevant documentation.
- Incorporation of assessment scales and respective evolution charts.
- Creation of info videos on topics related to active ageing (contributing to increased health literacy).