Bringing Efficiency and Safety in Homes Through Holistic Digital Technologies for Older Adults

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Abstract. As the aging population grows, healthcare systems face increasing challenges in managing frailty and chronic conditions. Frailty syndrome, characterized by weakness, fatigue, cognitive decline, and reduced physical activity, requires early detection and intervention to improve quality of life and prevent deterioration. This paper presents the implementation and evaluation of BONVITA, a modular digital platform designed to support frailty assessment, self-management, and shared care planning. BONVITA integrates a serious games mobile application for cognitive and physical function assessment, AI-driven risk prediction and patient stratification, and tools for remote rehabilitation, medication management, and lifestyle monitoring. A clinical study in Poland evaluated BONVITA with 20 older adults and a control group of equal size over a three-month period, assessing changes in functional status and quality of life using validated clinical tools. Formal and informal caregivers also participated, providing feedback on usability and impact. The platform enhances coordinated care through real-time alerts, personalized recommendations, and smart dashboards for healthcare professionals and caregivers. By leveraging AI-powered analytics, interactive assessments, and shared care tools, BONVITA enables early intervention and personalized care for frail and pre-frail individuals. Its scalable and adaptable design allows seamless integration into broader healthcare and social care settings, offering a sustainable model to support Europe's aging population.

Keywords: Integrated Care, Frailty, Artificial intelligence.

1   Introduction

The rapid aging of the global population presents a significant challenge for healthcare systems, particularly in industrialized nations where the proportion of individuals over 65 continues to rise. According to Eurostat, as of January 2023, individuals aged 65 and over comprised 21.3% of the European Union's population. This reflects a 3.0 percentage point rise compared to a decade earlier [1]. This demographic shift increases the prevalence of age-related conditions, particularly frailty, a syndrome characterized by weakness, fatigue, cognitive decline, and reduced physical activity [2]. Frailty not only affects an individual's independence and quality of life but also leads to higher hospitalization rates, increased healthcare costs, and greater demand for long-term care. Early detection and intervention are crucial to mitigating these risks and enabling older adults to maintain autonomy for as long as possible. Digital health solutions have emerged as promising tools for supporting frailty management, empowering both older adults and healthcare professionals. Mobile applications and artificial intelligence (AI)-driven platforms can enable continuous monitoring, early risk detection, and personalized interventions, reducing the burden on traditional healthcare services. However, existing solutions often lack integration, personalization, and coordination between different stakeholders, including healthcare professionals, informal caregivers, and older adults themselves [3].

This paper presents BONVITA [4], a modular digital platform designed to support frailty assessment, self-management, and shared care planning. BONVITA incorporates a serious games application to evaluate cognitive and physical function, alongside AI-driven risk prediction, patient stratification, and rehabilitation support. Its implementation was tested in a clinical study in Poland involving older adults, care professionals, and informal caregivers, aiming to assess the platform's impact on functional status, quality of life, and user experience in real-world conditions.

2   Methods

BONVITA is an advanced suite of digital tools for integrated care **Error! Reference source not found.** and shared care planning **Error! Reference source not found.**, designed to support older adults through home monitoring, self-management, and cognitive and physical wellness. It includes comprehensive geriatric assessment **Error! Reference source not found.** (CGA) tools, serious games through REHABILITY (https://www.rehability.me/), and a modular app for caregivers, professionals, and administrators. The BONVITA system comprises a home kit for older adults (including a Lattepanda device, REHABILITY games, and an RGBD camera), and a mobile/web app for care teams. Its content focuses on frailty screening, management, and self-care, using CGA as the gold standard for frailty diagnosis. The system includes tools like the Frailty Index calculator **Error! Reference source not found.**, EQ-5D **Error! Reference source not found.** and UCLA Loneliness Scale **Error! Reference source not found.** for assessing physical, cognitive, and emotional health. It also supports shared care planning, allowing role-based access to relevant stakeholders with the older adult's consent. BONVITA is flexible and can incorporate new assessments and functionalities.

REHABILITY (http://www.rehability.me/), a core component of BONVITA, enhances rehabilitation therapy by offering personalized motor and cognitive exercises through interactive games. This system motivates older adults to engage in therapy remotely, while therapists can monitor progress through rich analytics. BONVITA has been tested in Poland, with a clinical study involving older adults, caregivers, and a control group to evaluate its impact on functional status and quality of life.

The BONVITA platform was implemented in a pilot funded under the PHARAON project and a clinical study was undertaken. The clinical study followed a structured protocol approved by the local ethics committee, in accordance with national and EU regulations. Participants provided informed consent prior to enrollment. The study involved a three-month intervention with 20 older adults aged 65 and above using the BONVITA platform and a matched control group of 20 individuals. In addition to the older adults, six formal caregivers and five informal caregivers participated in the evaluation. Data collection focused on validated outcome measures related to functional status, quality of life, social isolation, and usability. All personal data collected during the study were processed in compliance with the General Data Protection Regulation (GDPR). Strict data management procedures were implemented, including anonymization, secure storage, and restricted access protocols to safeguard participant privacy and ensure ethical conduct throughout the study.

3   Results

A clinical study was conducted involving 20 older adults 65+ using the solution and 20 older adults 65+ in the control group. Additionally, the solution was utilized by 6 care providers and 5 informal caregivers. The study aimed to measure the impact of the solution on outcomes related to functional status and quality of life. The older adults were provided with a personalized care plan based on the clinical analysis during the comprehensive geriatric assessment (CGA). An individual plan for serious games was devised according to the older adult's needs and health status that was co-created with the end users based on individual CGAs. Further, data collection occurred throughout the pilot, and intelligent analytics were

conducted within the completed data sets in order to provide the necessary insights to care teams and older adults. A TV set was used in the older person's home to address limited access to technology. The platform aimed at addressing the multifaceted needs of older adults, focusing on physical conditions, mental health, and psychosocial wellbeing, particularly through the identification and screening of pre-frail status. Currently, the clinical study analysis is being conducted aiming to assess the impact that BONVITA may have on older people as well as on formal/ informal carers in terms of the Quality of Life and feelings of social isolation. Based on preliminary findings, the BONVITA platform has been well received, and participants state that engaging with the platform has helped them increase their physical activity and would like to recommend it to their friends.

4   Discussion

The state-of-the-art digital technology for older adults and their care teams, offers a unified approach to rehabilitation, integrated care and shared care planning that is personalized and can be delivered remotely, improving safety and efficiency while reducing the burden to the health care system without losing quality of service. Recognizing that older adults are less likely to have a smart phone or device; a home kit has been provided into older persons homes that could be easily accessed through own TV. Health professionals have the capacity to create a personalized rehabilitation program based on individual needs and limitations extending the comprehensive geriatric assessment to real time interventions with detailed. Shared care plans have been developed with the older adult at the centre of decision making and are modifiable based on real data and personal performance and activities. Serious games facilitate physical and cognitive exercising based on individualized goals. BONVITA enables accessibility to healthcare even to remote inaccessible areas and supports green economy. Social cohesion is promoted by enabling the user to communicate with other users, to formulate social groups and interact.

5   Conclusion/Implications for the AT field

This paper presents the implementation of a platform for enabling integrated self-care and wellbeing. The platform has been tested in a clinical study and the results are currently being analysed to address the impact the introduction of digital technology had in older adults life and wellbeing. The BONVITA platform demonstrates the potential of digital innovation in addressing the complex needs of frail and pre-frail older adults. By combining AI-powered assessments, personalized rehabilitation, and integrated care planning, it offers a holistic approach to supporting aging in place. The clinical study in Poland highlights its feasibility, acceptability, and positive influence on key health and wellbeing indicators. As Europe's aging population continues to grow, scalable and adaptable solutions like BONVITA can play a critical role in enabling proactive, person-centered care. Future research will further validate its impact and guide broader implementation across diverse care settings.

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