The Role of Embodied Conversational Agents in Supporting Older Adults with Hypertension: A Focus Group Study

Julio Oliveira[1][a], Telmo Silva[1][b], Rita Oliveira[1][c] and Elizabeth Furtado[2][d]
[1]*Digimedia, Universidade de Aveiro, Aveiro, Portugal*
[2]*Doutorado em Informática Aplicada, Universidade de Fortaleza, Fortaleza, Brazil*

Keywords: Embodied Conversational Agents, Hypertension, Focus Group, Non-Hedonic Applications.

Abstract: This paper investigates the essential tasks for Embodied Conversational Agents (ECA) to engage Older Adults in hypertension treatment effectively. The research addresses the growing need for innovative solutions to support aging populations and explores the potential of ECA to provide cognitive, emotional, and practical support. The central research question focuses on identifying the key tasks an ECA should perform to assist Older Adults in managing their hypertension. Through a Focus Group (FG) with healthcare professionals, the study identifies ten key tasks for ECA support, encompassing pharmacological (medication adherence and tracking) and non-pharmacological (dietary monitoring, exercise promotion, disease education, and communication facilitation) aspects of hypertension management. The FG was held online with seven participants (5 participants and 2 User Experience Specialists) in January 2023. The paper also discusses the broader challenges and considerations related to ECA engagement for Older Adults, including ethical concerns, user acceptance, and the importance of personalized and empathetic interactions. The findings emphasize the need for a tailored ECA design that considers individual patient needs, medical history, and preferences to maximize effectiveness and promote successful hypertension management.

1 INTRODUCTION

The growing prevalence of the world's ageing population has intensified the need for innovative solutions that promote independence, well-being, and social engagement among Older Adults (OA). Conversational Systems (CS) with Embodied Avatars, namely Embodied Conversational Agents - ECA, have emerged as a promising - and low-cost - technology to provide cognitive, emotional, and practical support for this demographic group (Yaghoubzadeh et al., 2013).

From the perspective of Embodied Conversational Agents (ECA), it is important to identify issues like features, recommendations, and characteristics of the agent and the dialogue specifically tailored for Older Adults. The primary challenge lies in identifying and relating the issues associated with this demographic to practical applications.

Our central research question (RQ) guiding this inquiry is: “What are the essential tasks for the use of ECA to engage Older Adults in the Treatment of Hypertension?”.

From that RQ, this paper seeks to delineate the main challenges encountered in engaging Older Adults in using ECA and then identify tasks to be done with the help of the ECA. The findings highlight the challenges of identifying an effective tailor for engaging Older Adults.

The contribution of this work is related to the development of ECA for the elderly, considering aspects of health care. The selection of important tasks can promote an improvement in the unpredictability of dialogs. The current use of Large Language Models (LLM) makes it necessary to create

[a] https://orcid.org/0000-0002-3516-0114
[b] https://orcid.org/0000-0001-9383-7659
[c] https://orcid.org/0000-0001-6041-9469
[d] https://orcid.org/0000-0002-1584-3161

Oliveira, J., Silva, T., Oliveira, R. and Furtado, E.
The Role of Embodied Conversational Agents in Supporting Older Adults with Hypertension: A Focus Group Study.
DOI: 10.5220/0013504300003938

In *Proceedings of the 11th International Conference on Information and Communication Technologies for Ageing Well and e-Health (ICT4AWE 2025)*, pages 433-442
ISBN: 978-989-758-743-6; ISSN: 2184-4984

prompts that allow greater engagement in the tasks described.

This paper is organized into four sections. The next section explores the challenges related to ECA development, particularly for Older Adults. The third section examines applications designed to support Older Adults in non-hedonic contexts. Following this, we present a dedicated section outlining ten essential tasks that the ECA should undertake to aid in managing hypertension treatment. Finally, we conclude with remarks on future work.

2 OLDER ADULT'S ENGAGEMENT

The growing adoption of voice technologies, particularly among the Older Adult population, raises several ethical issues that require in-depth analysis. Interaction with conversational voice systems, such as virtual assistants and chatbots, offers significant benefits, such as easier access to information and virtual companionship. However, it is crucial to consider the ethical aspects inherent in this relationship to guarantee a safe, respectful, and beneficial experience for the Older Adult (Patrão Neves, 2022).

Engagement has been a topic of debate across various domains, including education, management, marketing, and social media. It explores how individuals connect with activities, content, or communities, influencing their behavior and experience. Engagement is not just about producing meaning but also about impacting behavior through specific patterns. It involves a dynamic interaction between the user and the context, where cognitive and emotional responses play crucial roles. This complexity makes it challenging to define engagement in a universally applicable manner, as it is deeply rooted in subjective experiences and context-specific factors (Zagalo, 2020).

In the field of Human-Computer Interaction (HCI), engagement has been increasingly recognized as crucial for designing interactive experiences. It moves beyond mere usability and functionality to create meaningful and purposeful interactions. Engagement is linked to motivational patterns that drive users to participate and interact continuously, making it a key factor in maintaining user interest and satisfaction. It involves three main streams: progression, which relates to achieving goals; expression, which involves creativity and self-expression; and relation, which encompasses social connections and emotional bonds. This triadic approach provides a comprehensive framework for understanding and designing engaging experiences (Zagalo, 2020).

The measurement of engagement in this study will be conducted through a motivational interview(Mercado et al., 2023) with Brazilian and Portuguese Older Adults. The experiment will utilize videos of the ECA in conjunction with the scenarios described in this paper.

ECA collects vast amounts of personal data to function effectively, including voice recordings, command history, device information, and even biometric data such as voiceprint. This data's indiscriminate collection and long-term storage pose a significant risk to users' privacy.

Protecting the privacy of elderly users' is one big challenge related to storing sensitive personal information, such as health history and lifestyle habits, and requires robust security measures to prevent unauthorized access and misuse. Developers must be transparent about their data collection and use practices, guaranteeing users' informed consent (Hadian et al., 2019).

The vulnerability of the Oldeer Adults, often associated with loneliness and technological dependence, makes them potential targets for manipulation and exploitation. We need to be aware of the risk of using conversational systems for misleading advertising, selling inappropriate products and services, or even perpetrating crimes (Bickmore et al., 2018).

The growing prevalence of the world's ageing population has intensified the need for innovative solutions that promote independence, well-being, and social engagement among Older Adults. ECA have emerged as a promising - and low-cost - technology to provide cognitive, emotional, and practical support for this demographic group (Yaghoubzadeh et al., 2013).

ECA are designed for natural interaction in spoken and non-verbal language with the potential to aid daily tasks, facilitate communication, and even provide companionship. However, the success of these technologies depends heavily on ensuring user adoption and acceptance, a complex issue shaped by several factors, particularly how dialogues are staged (Knob et al., 2021).

Creating a successful conversational system for Older Adults requires a holistic understanding of their needs and preferences beyond technological functionality. Several critical factors and Challenges influence Older Adults' acceptance of and adherence to conversational systems.

These aspects are not unanimous, but the ones most often cited in the literature are related below.

Adapting to the needs of Older Adults is crucial for effective interaction. Agents designed to engage with human users as interlocutors must be able to adjust. Research in this area has focused on developing conversational agents, including virtual agents, robots (physical agents), and chatbots to adjust to the users' preferences. These preferences occur at various levels and are expressed through different social cues, including verbal and nonverbal communication and conversational strategies. (Woo et al., 2024)

To successfully engage in real-time and demonstrate expressive and adaptive behavior, an ECA must possess essential functionalities, such as Perception of the user's behavior, Agent's behavior, and Dialog management.

2.1 Perception of the Older Adult's Behavior

An agent interacting with a human user must respond appropriately to the user, considering their behavior, including speech and gestures. To achieve this, the agent must first perceive these signals, which can be categorized into three components: the content of the user's speech, the prosody of the speech, and the user's gestures (Woo et al., 2024).

The content of a user's speech is essential as it clearly communicates their intentions through language. This information is crucial for various automated systems that interact with users, as evidenced by conversational Artificial Inteligence (AI) assistants such as Google, Alexa, and Siri. To effectively capture this speech content, it is necessary to implement Automatic Speech Recognition (ASR), also referred to as Speech-to-Text (STT). ASR is a technology that transcribes spoken audio into written text, recognizing complete phrases and converting them in real-time as the user speaks (Woo et al., 2024)..

User's speech prosody plays a crucial role in expressing intentions that go beyond mere spoken words. It includes variations in voice qualities such as pitch (high or low), loudness (loud or soft), and duration (fast or slow), all of which are collectively known as speech prosody. To extract these prosodic features, audio feature extraction must be performed. The primary prosodic characteristics identified include fundamental frequency, which indicates pitch; loudness, which measures sound energy; voicing probability, assessing the ratio of unvoiced to voiced energy; and Mel-frequency Cepstral Coefficient (MFCC), representing the short-term power spectrum of sound (Woo et al., 2024).

The user's gesture needs to be captured to analyze the perception and generation of facial gestures, including facial expressions and head/gaze movements, of both the human user and the agent. The key features include gaze movements represented by angles concerning the x and y axes, head movements characterized by Euler rotations around the x, y, and z axes, and facial expressions identified through Action Units (AUs) as defined by the Facial Action Coding System (FACS) (Ekman & Friesen, 2019; Woo et al., 2024).

2.2 Agent's Behavior

The agent's behavior is intricately linked to its ability to adapt based on both user interactions and its own historical behaviors. This dual dependency necessitates a sophisticated perception mechanism that allows the agent to monitor and evaluate its actions in relation to its current intentions, such as synchronizing lip movements with speech output. Integrating these elements allows the agent to enhance responsiveness and create a more coherent interaction experience.

The challenge to achieving this level of self-awareness is linked to an internal memory system that retains a record of its most recent behaviors, including speech content and prosody. This memory needs to store a large number of instances of user behavior but also tracks the agent's own displayed behaviors, thereby facilitating a comprehensive understanding of its performance and enabling it to adjust its actions accordingly (Woo et al., 2024; Woo, Grimaldi, et al., 2023).

The behavior signals perceived by human users and agents play a crucial role in generating expressive and adaptive behaviors in artificial agents. The Augmented Self-Attention Pruning (ASAP) model, as introduced by Woo et al. (2023), is designed to create expressive facial gestures for agents that adapt reciprocally to their interactions. The ASAP model employs self-attention pruning and data augmentation techniques to enhance learning capabilities (Woo, Pelachaud, et al., 2023).

A significant feature of the ASAP model is its ability to ensure continuity in the generated behaviors. This is achieved through autoregressive adaptive online prediction, which allows the model to maintain a seamless flow in the agent's actions. (Woo, Pelachaud, et al., 2023).

Integrating the pre-trained ASAP model into the system significantly advances the rendering of

expressive and adaptive visual behaviors in agents. By processing the perceived visual and audio features from the previous steps of both the human user and the agent, the model can predict and generate the agent's behavior for the subsequent time step. This predictive capability is essential for creating a more interactive and engaging user experience (Woo, Pelachaud, et al., 2023).

2.3 Dialog Management

Effective management of dialogue in conversations relies on a turn-taking mechanism that allows interlocutors to influence the direction of the discussion based on the content of their speech. For an agent to successfully engage in real-time conversations with human users, it is essential to replicate this turn-taking behavior.

The process initiates with an automatic speech recognition (ASR) system that captures the user's spoken utterance. This captured text is subsequently transmitted to a dialog engine. By leveraging this framework, the dialog engine can effectively analyze the input and determine the most suitable next step in the conversation, promoting a seamless interaction between the agent and the user.

There are three key reasons for considering the inclusion of non-verbal modalities in the dialog. The first reason is rooted in human factors. In face-to-face communication, regardless of our language, cultural background, or age, we all incorporate our facial expressions and hand gestures as essential components of our communication. The additional factors stem from the interplay between computers and human users. The second concerns the need for human access to more than one modality in noisy situations. In situations like real life, non-verbal modalities come into play: a smile, a shoulder movement, and so on (Cassell, 1998).

The challenge is to allow the agent to make gestures and the Older Adult consider it as a part of the dialog. Cassell suggests the use of Emblems, like the V of victory, and Propositional Gestures, like the use of the hand to show the size of a cup. The third type is Spontaneous Gestures, such as pointing to a slide, for example (Cassell, 1998).

The integration of gesture and speech is a crucial consideration. At the word level, it is essential to temporally align both individual gestures and spoken words, ensuring that the most dynamic aspect of the gesture coincides with or precedes the syllable that carries the greatest intonational emphasis in the accompanying speech segment. This alignment presents one of the challenges in achieving effective integration (Cassell, 1998).

When the Agent articulates a word, various physical actions need to be made, such as eye blinks, hand movements, head turns, and brow raises take place, concluding at the end of the word. This synchrony is evident across all levels of speech, including phonemic segments, words, phrases, and longer utterances (Cassell, 1998). The reality of these movements can facilitate communication with Older Adults or give them a false clue about what is happening.

Although it is crucial for promoting trust and involvement, it can cause serious problems if implemented improperly. The main difficulties identified are related to the subtleties of human communication and cultural diversity among those involved in contingency and responsiveness (Kopp & Hassan, 2022).

Modeling verbal behavior with the nuances of human emotion is quite complex (Yaghoubzadeh et al., 2015). However, these subtleties must not be exaggerated or underestimated, and the system must respond to the user's needs and current state.

Contextual factors and individual preferences must be considered to create and implement empathy through dialogue. Generic approaches can lead to frustration. Therefore, the system's response and the level of empathy must be personalized (Yalcin, 2019).

3 NON-HEDONIC APPLICATIONS

Non-hedonic applications for Older Adults refer to tools, technologies, and services designed to enhance their quality of life without focusing primarily on pleasure or enjoyment. These applications aim to support daily living, promote health, and foster social connections (Zhang & Umemuro, 2013).

One of the applications of ECAs for Older Adults is in the realm of companionship. Loneliness and social isolation are prevalent issues among the elderly, often leading to detrimental effects on mental and physical health (Bousardt, 2022).

Loneliness is a common problem among the Older Adults, and conversational systems can also offer virtual companionship through friendly conversations, games, and hedonic activities (Esposito et al., 2021). In addition, they can provide information on cultural events, news, and other activities of interest. Conversational systems can

offer online courses and training, stimulating continuous learning and the development of new skills (Da Paixao Pinto et al., 2021).

ECA can provide a sense of presence and engagement, offering conversation and interaction that can alleviate loneliness. By utilizing Natural Language Processing (NLP) and emotional recognition, these agents can adapt their responses to the emotional state of the user, fostering a more personalized and meaningful interaction. This companionship can benefit those with limited social networks or mobility constraints (Kramer et al., 2022).

However, there is inconsistent evidence on whether intention translates into actual usage. Since actual use is essential for realizing health benefits, it occupies a central role in the model. Increased engagement with ECA is anticipated to enhance the quality of the relationship formed, leveraging the agents' ability to foster empathy. The model posits that usability and perceived usefulness serve as precursors to actual use, with improved usability leading to heightened perceived usefulness (Kramer et al., 2022).

The classification system proposed by Teixeira et al. (2012) is utilized to generate hypotheses regarding which techniques effectively enhance specific psychological needs. The study's objectives include determining whether ECA can motivate community-dwelling Older Adults to modify their dietary habits and reduce feelings of loneliness, assessing the mechanisms behind these outcomes, and gaining insights into the usage of ECA (Teixeira et al., 2012).

The health sector stands out as one of the main fields of application. These tools can help monitor chronic conditions, remind Older Adults to take medication, schedule medical appointments, and provide information on healthy lifestyle habits ("Telehealth Innovations in Remote Healthcare Services Delivery - Global Telehealth 2020," 2021).

In Health Care, the challenge is related to the type of content, the security of the information, and the presence of functionalities related to the collection of biomedical data. The challenges lie in supporting the Older Adult with simple medical treatments, whether drug treatment or lifestyle-related. The use, however, needs to be more widely accepted to make treatments effective and assist the medical team in treating chronic diseases. Even though ECA can make life easier for Older Adults, they need to trust and establish a relationship with the system.

The study performed by Car et al. (2020) identified several different themes: Treatment and Monitoring, Health Care Services Support, Education, Lifestyle Behavioral Changes, and Diagnosis. The healthcare sectors identified for conversational agent applications were generally broad, mentioning a few specialties, including mental health, neurodegeneration, metabolic medicine (such as obesity and diabetes), and sexual health. Future applications could expand into other healthcare fields with the potential for digital health interventions, such as dermatology, primary care, geriatrics, and oncology (Car et al., 2020).

ECAs can significantly contribute to the management of health for senior individuals. Many Older Adults face chronic health conditions requiring ongoing monitoring and management. ECAs can assist in medication reminders, health tracking, and providing information about medical conditions. By engaging users in conversations about their health, these agents can encourage adherence to treatment plans and promote healthier lifestyle choices. Furthermore, the ability of ECAs to collect and analyze data on user behavior can provide valuable insights for healthcare providers, enabling more tailored and effective interventions.

Another significant application of ECAs is in enhancing cognitive engagement among Older Adults. Cognitive decline is a common concern as individuals age, and maintaining mental acuity is essential for overall well-being. ECAs can facilitate cognitive exercises and games that stimulate mental activity, helping to keep the mind active and engaged. By providing a fun and interactive platform for cognitive training, these agents can motivate Older Adults to participate in activities that promote cognitive health. Additionally, the social interaction provided by ECAs can further enhance cognitive function by encouraging communication and socialization.

ECA can serve as a bridge to technology for Older Adults, who may feel intimidated by modern devices and applications. ECAs can help older individuals navigate technology more comfortably by providing a user-friendly interface that mimics human interaction. This can increase engagement with digital resources like telehealth services, online communities, and educational platforms. Older adults can access a wealth of information and services to improve their quality of life as they become more adept at using technology. Applying Embodied Conversational Agents to Older Adults presents a multifaceted approach to addressing this demographic's unique challenges, ultimately enhancing their social, emotional, and cognitive well-being.

ECA, with special sensors and wearable devices, can track vital signs, medication adherence, and physical activity levels. These interactive tools may assist Older Adults in managing chronic conditions and proactively maintaining their health.

Remote consultations by telehealth can facilitate access to healthcare professionals, by enabling Older Adults to receive medical advice and treatment without the need to leave their houses, thereby improving access to Health Care.

The applications can be designed to stimulate cognitive function through interactive puzzles, memory games, and problem-solving tasks using voice and help them maintain mental acuity and delay cognitive decline.

The possibility of communication with family and friends through video calling and social media platforms can be made by supporting ECA to combat loneliness and promote social engagement.

The offer of smart home technologies to Older Adults, including fall detection systems, emergency response buttons, and environmental sensors, ensures a safe living environment and can be connected to family members and the health care system.

The assistance of alimentation habits with the possibility of meal planning and grocery delivery services tailored to the dietary needs of Older Adults, ensuring access to healthy and balanced meals, can be held with the support of nutrition professionals.

Daily exercises specifically designed for Older Adults can be performed by the ECA, promoting physical activity and helping to maintain mobility and strength.

By focusing on these applications of embodied conversation agents, we can create a supportive ecosystem that enhances the well-being of Older Adults, allowing them to live independently and with dignity.

4 TASKS FOR THE TREATMENT OF HYPERTENSION

A focus group was conducted to assess the utilization of ECA among Older Adults within a healthcare environment. The online session took place in January 2023 and included five participants, as detailed in Table 1, along with two UX specialists. The session lasted a total of 80 minutes.

The criteria used to recruit of participants was by convenience. Participant (P) P1 is a researcher at Aveiro University and is a member of a research project involving Older Adults and technology. P2 has a Master's degree and is in the medical residency period. P3 is a professor at the University School of Health, and P4 is also a teacher at the University in Brazil and works in a government health center. P5 worked in public hospitals in São Paulo, Brazil, and is currently on a sabbatical leave. All participants agreed to have their records taken for research purposes.

Table 1. Participants of Focus Group.

Subject	Rule	Gender, Country
P1	Gerontologist	Female, PT
P2	Recently graduated physician	Female, PT
P3	Physiotherapist	Male, PT
P4	Cardiologist	Female, BR
P5	Geriatric Physician	Male, BR

The mediator introduced everyone and requested authorization to record audio from the FG session. The discussion was legitimized by explaining the context of the research and the Research Project being conducted. The research question, the context of the study, and the objectives were also presented.

After that, the key concepts of ECAs - Embodied Conversational Agents, Treatment of Hypertension, and Older People were shared with participants. The goal of FG was then, presented:

> "The use of ECA by Older Adults with Hypertension can be realized; If so, what tasks can assist the patients?"

A video demonstrating an example of an ECA dialogue was presented to remind an elderly woman to take her heart medication. The actress featured in the video was selected for convenience, ensuring that the identified tasks were relevant to technologically literate seniors facing challenges with self-managing their hypertension treatment. Additionally, the actress signed a document granting permission for her appearance to be shown to the focus group participants.

After the video, participants started with the considerations about the use of ECA using the Persona shown in Figure 1. Then, the mediator opened the space for each participant to make considerations about the theme and indicate the tasks that the assistant could support.

The method used to select the tasks involved brainstorming. The facilitator began by explaining the goal and inquired about what ECA should and should not do. Each participant contributed a set of tasks, leading to a discussion. As the tasks were presented, some were excluded while others emerged. The input from medical participants highlighted certain risks and the need to avoid specific tasks.

Magda Barbosa | 76yo | Single
"I like Technology, and I use it to improve my daily life"
She lives alone, can't remember to take medication, loves salty food, and she is sedentary.
Has a Google Nest to listen to music and ask for forecasts daily.
She writes down some sticky notes to remind herself of her medications.

Figure 1. Persona to be considered to use an ECA.

The UX specialists actively engaged in the discussion by assessing the usability of the ECA in executing the proposed tasks. They provided support to the medical participants, and the diverse insights shared underscored the necessity to refine the objectives and methodologies for each task to promove engagement.

A total of ten tasks were identified that could benefit from ECA support, which included two pharmacological tasks (T1 and T2) and eight non-pharmacological tasks (T3 to T10). The proposed tasks are detailed in Table 2.

Task 1 involves following up on medications, while Task 2 focuses on tracking the amount of each medication, as suggested by P1 and P3. However, it is important to avoid using typical alarms to remind Older Adults. Instead, a more empathetic dialogue should be established to achieve the desired goal.

The third task, while categorized as non-pharmacological, involves the medical consultation. Participants noted the challenges Older Adults face in remembering all the information provided by the doctor. Important details may be overlooked as the sessions extend. A significant advancement is the utilization of comprehensive records of all recommendations, which can and should be leveraged to inform other tasks, whether to determine the type of advice to offer or to issue alerts.

Other tasks can assist Older Adults in staying on track. Regular monitoring of blood pressure (T5) is essential, as it helps maintain heart health and identify potential issues early. Furthermore, proposing and following up on physical activities (T6) can significantly enhance overall well-being; simple exercises such as walking or stretching can make a substantial difference. The frequency of blood pressure monitoring and the amount of exercise should be coordinated with the health team's guidance. The cardiologist emphasized that an analysis of all comorbidities must be carried out before defining an exercise plan for a patient with hypertension.

Suggest and assist in developing comprehensive diets that are nutrient-dense, as proper nutrition is crucial for sustaining health (T7). Participants cautioned against utilizing the Medical Record (MR) solely to offer recommendations that do not consider other comorbidities. This task is bound by clear ethical constraints, as the information contained in medical records may not always be accessible on platforms beyond hospital settings (Xie et al., 2018).

The Task number 8 identify daily activities that may impact your treatment. To inform of how certain habits or routines affect the health helps to make better choices. However, the participants were not all convinced that this task could be performed by a computer device. The inherent risks of an elderly person's routine must be considered on a case-by-case basis and cannot be performed based on random suggestions or suggestions of dubious origin. Continuous learning from tasks that are already performed and suggestions made by the medical team can make this complex task more feasible.

One aspect reported in connection with this task is related to a possible characteristic of the ECA in monitoring the elderly person in the tasks they perform and reacting autonomously without the elderly person's request. From the participants' point of view, the elderly person will not authorize or feel comfortable, if they do authorize, for the equipment to monitor them. Therefore, the only way would be to question the user and analyse what they say.

Disease literacy is crucial for effective treatment. Task 9 focuses on delivering relevant news to Older Adults concerning HTA health treatment. Suggestions can be made through discussions on various topics, and within the bounds of medical advice, these can help prevent misguided actions. Participants in the focus group are particularly mindful of the information level that needs to be conveyed to ensure it is effective for each patient's medical condition.

General information can lead to confusion and may impede patients' decision-making. Consequently, the proposed task should be approached with care, taking into account the knowledge, culture, and educational background of each individual user. Coronary risks identified by Participant P4 must be considered to prevent the establishment of inappropriate guidelines. Additionally, it is essential to recognize the significant risks associated with other comorbidities on an individual level before developing a specific scenario.

The last task proposed for the ECA is related to keeping the elderly adult connected with the entire care team, whether formal or informal. The possibility of opening direct video connections with nurses, caregivers, relatives and even doctors can prevent, among other things, emergency situations from being ignored.

A set of assumptions were reported by the participants: the availability of the medical team, the level of knowledge of caregivers and relatives and also ethical and safety aspects related to video contacts. They unanimously indicated that this function can enhance user engagement by allowing other communications not necessarily related to health.

Table 2. Tasks proposed to be supported by the ECA.

#	Task
T1	Follow up on medication schedules
T2	Keep track of the number of pills of each medication in the home pharmacy
T3	Record and transcript the audio of the physician's appointment, identifying the key information to personalize the other tasks
T4	Keep track of the amount of sodium ingested
T5	Monitor blood pressure
T6	Propose and follow up on physical activities
T7	Suggest and help with elaborate diets
T8	Identify daily activities that may impact on treatment
T9	Inform about the disease
T10	Allow contact with the medical team, caregivers, and family members

The two pharmacological tasks proposed for medication monitoring are usual and can be performed without the need for an ECA. However, an empathic approach was indicated so that the patient does not feel charged about medication schedules and amounts in an untimely manner. Suggestions are pointed out for the use of other subjects to make a rich and meaningful dialogue. In the participants' speeches, it is crucial that proactive interactions by ECA are conducted with care to avoid instilling fear in the dialogue, especially when such interactions are considered untimely.

The analysis reveals that the urgency of various tasks is not uniform across all patients. Each older adult presents unique limitations, characteristics, and needs as determined by their physician. These individual factors significantly influence the proposed execution of tasks T3 to T10. It is essential to assess the patient's environment, along with their medical prescriptions and guidelines, prior to implementation. The primary rationale for customizing tasks lies in the directives provided by the physician, which are informed by the patient's health history.

In the FG audio transcription stage, considerations were made and identified. Three groups of considerations were identified: Agent Characteristics, Aspects related to the use of technology by the Older Adults and Tasks to be supported by the ECA.

The characteristics of the ECA agent referenced by the participants converged on a humanized avatar, with physical characteristics reminiscent of someone trustworthy and with some authority. The need for an avatar adapted to the context of the Older Adults was reiterated to the patient to be motivated.

The need for a physical avatar was identified as an aspect that can negatively influence interaction. For this feature to become an advantage, a connection with someone from the patient's real context is needed. Impersonation (sense of humor), voice, accent and intonation were cited.

5 FINAL REMARKS

This study explored the potential of ECA to support Older Adults in managing hypertension, a prevalent health concern within aging populations. Through a Focus Group with Health Care professionals and UX Specialists, we identified ten key tasks that ECAs could effectively address, ranging from medication reminders and tracking to promoting healthy lifestyle choices like diet and exercise.

The results highlight the ability of ECA to connect technological progress with the unique requirements of Older Adults, providing a tailored and user-friendly method for managing chronic diseases. The focus group participants highlighted the importance of a humanized and trustworthy ECA avatar, emphasizing the need to consider the agent's characteristics and dialogue carefully to ensure user acceptance and engagement.

Participants were chosen based on convenience and the nature of their work. Since they are located in different countries, we scheduled an online meeting at a time that was convenient for everyone.

The research also highlights the broader challenges of developing and deploying ECA for Older Adults. Ethical considerations, particularly regarding data privacy and security, emerged as crucial concerns. Protecting sensitive health information and ensuring transparency in data collection practices are paramount for building trust and fostering a positive user experience.

Furthermore, the study emphasized the importance of tailoring ECA to individual needs and

preferences, acknowledging the diverse range of abilities and technological literacy among Older Adults. A one-size-fits-all approach is unlikely to be effective, and personalized interactions are essential for maximizing engagement and promoting long-term adherence to hypertension management plans.

Beyond the specific context of hypertension, this work contributes to a broader understanding of how ECA can be leveraged to support healthy aging. The identified tasks and considerations are applicable to a range of non-hedonic applications, including companionship, cognitive stimulation, and access to telehealth services.

By providing a user-friendly interface and personalized support, ECAs can empower Older Adults to maintain their independence, improve their well-being, and actively participate in their own care. Future research should focus on developing and evaluating ECAs in real-world settings, exploring their long-term impact on health outcomes and user satisfaction.

In conclusion, this study provides valuable insights into the essential tasks and key considerations for developing effective ECAs for Older Adults with hypertension. The ten tasks identified by the focus group offer a practical framework for designing and implementing ECAs that can positively impact hypertension management and overall well-being. By addressing ethical concerns and prioritizing personalized interactions, ECAs hold significant promise as a valuable tool for supporting healthy aging and empowering Older Adults to live more independent and fulfilling lives.

6 FUTURE WORK

The subsequent steps involve presenting the identified tasks to the elderly population. This will be conducted through motivational interviews with both Brazilian and Portuguese seniors, as a functional prototype is currently unavailable.

Additionally, the process includes the development of a doctoral thesis focused on Information and Communication on Digital Platforms at the University of Porto and the University of Aveiro.

REFERENCES

Bickmore, T. W., Trinh, H., Olafsson, S., O'Leary, T. K., Asadi, R., Rickles, N. M., & Cruz, R. (2018). Patient and consumer safety risks when using conversational assistants for medical information: An observational study of siri, alexa, and google assistant. *Journal of Medical Internet Research*, *20*(9). https://doi.org/10.2196/11510

Bousardt, H. M. (2022). *Using Embodied Conversational Agents to Combat Loneliness in Older Adults: A Scoping Review* [Master]. University of Twente.

Car, L. T., Dhinagaran, D. A., Kyaw, B. M., Kowatsch, T., Joty, S., Theng, Y. L., & Atun, R. (2020). Conversational agents in health care: Scoping review and conceptual analysis. In *Journal of Medical Internet Research* (Vol. 22, Issue 8). JMIR Publications Inc. https://doi.org/10.2196/17158

Cassell, J. (1998). *Embodied Conversation: Integrating Face and Gesture into Automatic Spoken Dialogue Systems*. '.

Da Paixao Pinto, N., Dos Santos Franca, J. B., De Sa Sousa, H. P., Vivacqua, A. S., & Garcia, A. C. B. (2021). Conversational Agents for Elderly Interaction. *Proceedings of the 2021 IEEE 24th International Conference on Computer Supported Cooperative Work in Design, CSCWD 2021*, 61–66. https://doi.org/10.1109/CSCWD49262.2021.9437883

Ekman, P., & Friesen, W. V. (2019). Facial Action Coding System. In *PsycTESTS Dataset*. https://doi.org/10.1037/t27734-000

Esposito, A., Amorese, T., Cuciniello, M., Riviello, M. T., & Cordasco, G. (2021). How Human Likeness, Gender and Ethnicity affect Elders'Acceptance of Assistive Robots. *Proceedings of the 2020 IEEE International Conference on Human-Machine Systems, ICHMS 2020*, 1–6. https://doi.org/10.1109/ICHMS49158.2020.9209546

Hadian, M., Altuwaiyan, T., Liang, X., & Li, W. (2019). Privacy-preserving voice-based search over mHealth data. *Smart Health*, *12*, 24–34. https://doi.org/10.1016/j.smhl.2018.04.001

Knob, P., Dias, W. S., Kuniechick, N., Moraes, J., & Musse, S. R. (2021). Arthur: a new ECA that uses Memory to improve Communication. *Proceedings - 2021 IEEE 15th International Conference on Semantic Computing, ICSC 2021*, 163–170. https://doi.org/10.1109/ICSC50631.2021.00036

Kopp, S., & Hassan, T. (2022). The Fabric of Socially Interactive Agents: Multimodal Interaction Architectures. In *The Handbook on Socially Interactive Agents* (pp. 77–112). ACM. https://doi.org/10.1145/3563659.3563664

Kramer, L. L., Van Velsen, L., Clark, J. L., Mulder, B. C., & De Vet, E. (2022). Use and Effect of Embodied Conversational Agents for Improving Eating Behavior and Decreasing Loneliness Among Community-Dwelling Older Adults: Randomized Controlled Trial. *JMIR Formative Research*, *6*(4). https://doi.org/10.2196/33974

Mercado, J., Espinosa-Curiel, I. E., & Martínez-Miranda, J. (2023). Embodied Conversational Agents Providing Motivational Interviewing to Improve Health-Related Behaviors: Scoping Review. In *Journal of Medical*

Internet Research (Vol. 25, Issue 1). JMIR Publications Inc. https://doi.org/10.2196/52097

Patrão Neves, M. do C. (2022). Criteria for Ethical Allocation of Scarce Healthcare Resources: Rationing vs. Rationalizing in the Treatment for the Elderly. *Philosophies*, *7*(6). https://doi.org/10.3390/philosophies7060123

Teixeira, V. D., Pires, C. G., Pinto, F. M., Freitas, J., Dias, M. S., & Rodrigues, E. M. (2012). Towards elderly social integration using a multimodal human-computer interface. *Proceedings of the 2nd International Living Usability Lab Workshop on AAL Latest Solutions, Trends and Applications, AAL 2012, in Conjunction with BIOSTEC 2012*, 3–13. https://doi.org/10.5220/0003852800030013

Telehealth Innovations in Remote Healthcare Services Delivery - Global Telehealth 2020. (2021). In C. H. M. E. L. van den B. C. G. Anthony J. Maeder (Ed.), *Studies in Health Technology and Informatics* (Vol. 277).

Woo, J., Grimaldi, M., Pelachaud, C., & Achard, C. (2023). IAVA: Interactive and Adaptive Virtual Agent. *Proceedings of the 23rd ACM International Conference on Intelligent Virtual Agents, IVA 2023*. https://doi.org/10.1145/3570945.3607326

Woo, J., Pelachaud, C., & Achard, C. (2023). ASAP: Endowing Adaptation Capability to Agent in Human-Agent Interaction. *Proceedings of the 28th International Conference on Intelligent User Interfaces*, 464–475. https://doi.org/10.1145/3581641.3584081

Woo, J., Shidara, K., Achard, C., Tanaka, H., Nakamura, S., & Pelachaud, C. (2024). Adaptive virtual agent: Design and evaluation for real-time human-agent interaction. *International Journal of Human Computer Studies*, *190*. https://doi.org/10.1016/j.ijhcs.2024.103321

Xie, C., Yang, P., & Yang, Y. (2018). Open Knowledge Accessing Method in IoT-Based Hospital Information System for Medical Record Enrichment. *IEEE Access*, *6*, 15202–15211. https://doi.org/10.1109/ACCESS.2018.2810837

Yaghoubzadeh, R., Kramer, M., Pitsch, K., & Kopp, S. (2013). Virtual Agents as Daily Assistants for Elderly or Cognitively Impaired People. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics): Vol. 8108 LNAI* (pp. 79–91). https://doi.org/10.1007/978-3-642-40415-3_7

Yaghoubzadeh, R., Pitsch, K., & Kopp, S. (2015). *Adaptive Grounding and Dialogue Management for Autonomous Conversational Assistants for Elderly Users* (pp. 28–38). https://doi.org/10.1007/978-3-319-21996-7_3

Yalcin, O. N. (2019). Evaluating Empathy in Artificial Agents. *2019 8th International Conference on Affective Computing and Intelligent Interaction, ACII 2019*, 290–296. https://doi.org/10.1109/ACII.2019.8925498

Zagalo, N. (2020). *Engagement Design* (D. Tan & J. Vanderdonckt, Eds.). Springer International Publishing. https://doi.org/10.1007/978-3-030-37085-5

Zhang, J., & Umemuro, H. (2013). Older adults' hedonic and eudaimonic well-being in information and communication technology activities. *Gerontechnology*, *10*(4), 231–243. https://doi.org/10.4017/gt.2012.10.4.004.00