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Research Article

Harnessing Artificial Intelligence for Early and Evolution of Alzheimer's Disease Detections and Enhancing Senior Mental Health through Innovative Art-Singing Therapies: A Multidisciplinary Approach

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Abstract

The well-documented therapeutic potential of group singing for patients living with Alzheimer's disease (PLAD) has been hindered by COVID-19 restrictions, exacerbating loneliness and cognitive decline among seniors in residential and long-term care centers (CHSLDs). Addressing this challenge, the multidisciplinary study aims to develop a patient-oriented virtual reality (XR) interaction system facilitating group singing for mental health support during confinement and enhancing the understanding of the links between Alzheimer's disease, social interaction, and singing. The researchers also propose to establish an early AD detection system using voice, facial, and non-invasive biometric measurements and validate the efficacy of selected intervention practices. The methodology involves co-designing an intelligent environment with caregivers to support PLAD mental health through online group singing, addressing existing constraints in CHSLDs. The researchers will engage volunteers in remote singing interactions and validate the impact of voice stimulation for PLADs using a control group. The primary expected outcome is the development of an "Intelligent Learning Health Environment," fostering interactions while adapting to individual PLAD situations and incrementally accumulating knowledge on AD signs. This environment will facilitate the transfer of knowledge and technologies to promote non-verbal interactions via singing, enabling intervention at the first symptoms. Additionally, the research will contribute to transforming CHSLDs' living environments, informed by neuroscience insights, and potentially extend the "collaborative self-care" approach to support seniors in aging safely and healthily at home.

Introduction

Group singing has been identified as a potent activity that fosters social interactions and well-being among PLAD, even at advanced disease stages [1]. Remarkably, PLADs can recall childhood songs despite losing the memory of their relatives' names, suggesting that singing activates specific memory components [2]. As a result, group singing initiatives have flourished in nursing institutions, targeting wellness goals for PLADs [3]. However, the COVID-19 pandemic and consequent social distancing measures have curtailed these gatherings, intensifying the sense of isolation for seniors in residential and long-term care centers (CHSLDs). Loneliness, an aggravating factor or trigger for Alzheimer's Disease (AD), has further strained nursing staff and caregivers in these facilities [4].

As the senior population and prevalence of AD are projected to increase, it's crucial to adopt innovative solutions to promote collective well-being [5]. Our project aspires to foster interactions through group singing, a vital pillar of mental health, especially for seniors confined or facing outing risks. The project aims to coalesce, experts, citizens, and caregivers in conceptualizing a patient-oriented virtual reality (XR) interaction system that integrates singing for well-being and addresses the mental health needs of PLADs. It further seeks to understand the interplay between AD, social interaction, and singing with caregivers' support, thereby aiding the identification of PLADs' mental health needs. Our model proposes to implement an early AD detection system that utilizes voice, facial, and non-invasive biometric measurements. Lastly, we aim to validate intervention effectiveness, engage volunteers to facilitate remote singing interactions, and transform CHSLDs. The project's implications are outlined in four key objectives.

Our proposed model advocates for the co-design of an intelligent environment with caregivers, aiming to bolster PLADs' mental health through online group singing, within the constraints and resources of existing CHSLDs. This model envisions a co-constructed system for monitoring AD progression through facial and vocal cues, public involvement in online singing groups to support PLADs, validation of voice stimulation impacts with a control group, and dissemination of project outcomes. The anticipated deliverables include an "Intelligent Learning Health Environment" that fosters interaction and adjusts to individual PLAD situations, gradually amassing specific knowledge on AD signs. This interactive environment will promote non-verbal interactions through singing, allowing for early symptom intervention. Furthermore, it holds the potential to transform CHSLDs' living environments and possibly extend the "collaborative self-care" proposal, enabling seniors to maintain health and safety at home for extended periods. The subsequent sections of this study will elaborate on the proposed research, encompassing elements like literature review, methodology, data collection and analysis, and intervention design.

Literature review

The COVID-19 pandemic, Archambault, et al. [6]. Reported, has imposed confinement on seniors in residential and long-term care centers (CHSLDs), exposing their feelings of abandonment and loneliness. The detrimental impact of isolation on their mental health has been substantial, with a 60% risk of developing dementia, including Alzheimer's disease (AD), in socially isolated seniors, much higher than in non-isolated senior populations [7]. In Quebec, AD prevalence is rapidly increasing, with projections estimating 180,000 affected individuals by 2030 [8]. Managing patients in the public health network represents a significant challenge, and CHSLDs must prepare for this expansion, Gabet, et al. [9]. Argue. Furthermore, the quality of life in CHSLDs is a concern for managers, caregivers, and care staff who experience significant stress due to anxiety experienced by seniors with AD. Such anxiety creates a challenging environment for all parties and limits their activities. In such circumstances, promoting appropriate social interactions for seniors with sensory, memory, and communication difficulties becomes crucial. Although medication is often administered to address crisis situations, this approach offers only palliative support, as a cure is not envisaged [10].

Therefore, an alternative, sustainable approach is essential for improving the mental health of seniors in CHSLDs. Low-cost interventions can be implemented to ensure that the living environment promotes prevention: 1) through interactions that achieve a relational balance between caregivers, the living environment, and seniors with AD, and 2) via early detection of AD signs. The following sections will explore the existing literature on non-pharmacological interventions, the benefits of social interactions and group singing for PLADs, and the potential of technology to facilitate these interactions and detect early AD signs [11,12]. Potential solutions apt for CHSLDs, especially during confinement, could include Intelligent Environments (IE), adaptable for the living settings of PLADs. IE can non-invasively merge with existing environments, interacting when needed through Internet of Things (IoT) systems [13]. These systems allow online connections and systematic patient monitoring, making them suitable for early detection of AD symptom progression in home settings. However, online social activities can seem physically disconnected or unadapted for seniors, who often view technology as constraining [14].

Addressing this challenge, remote communication becomes crucial for transforming care and monitoring the aging population, given structural limitations, staff shortages, increased life expectancy, and a growing senior demographic [15]. Hence, one research area focuses on reproducing corporeal effects during remote interactions [16]. Exploring the role of singing in this context becomes interesting, as group singing can improve social interaction quality, reduce stress, and foster a sense of well-being [17,18]. Singing stimulates

non-verbal interactions and engages breathing, abdominal support, and neuroelectrical activity, potentially benefiting memory and eliciting joy [19]. Despite these potential benefits, the stimulating effect of singing on neural activity is not widely used in mental health support for AD patients.

This study investigates how virtual group singing activities can emulate the effectiveness of in-person sessions, especially in the context of the 2020 health crisis that suspended all group activities. Another postulate explores the significance of establishing an early diagnosis using remote biometric-sound-visual signals [20]. Remote participation can meet a threefold objective: support social connection, promote the positive effects of singing, and guide users toward AD progression monitoring services. The following sections will elaborate on the methodology for developing and evaluating virtual group singing activities and environments [21]. Tackling the challenges and opportunities of remote implementation.

Research hypotheses and objectives

Our main objective will be to produce a workflow in order to take into consideration all the various expertise in order to proceed, our study examines the expected hypotheses that emerge from our pre-discussions in order to address the question of how we use an Intelligent Detection/Validation system that could include Group Singing Interaction Environment (IDSIE) in order to improve the quality of life of the patient living with Alzheimer, as well as his caregiver and nurse staff in CHSLDs. We collected these 5 main expected outcomes, that could assess the capacity of the IDSIE to:

1. Reproduce a psychosomatic effect similar to that of in-person sung interactions by enhancing the musical scenography with tactile, haptic, and olfactory elements, rather than relying exclusively on visual-sound systems. This approach takes into account the significant auditory challenges that PLADs may face, which could be a contributing factor to the disease.

2. Transform the living environments of CHSLDs through remote group singing, utilizing virtual gatherings of family and friends as an online human network, alternate realities, and sung virtual activities to reduce stress levels and create multiple opportunities for social interaction.

3. Monitor the progression of Alzheimer's disease via sign detection and recognition.

4. The research aims to demonstrate the lasting impact of remote group singing on the mental health of seniors and validate the impact of the IDSIE on mental health, all while being affordable and easily installable in any room.

5. Additionally, the study aims to investigate how a workflow could the feasibility of remotely validating the effectiveness of these virtual interventions while allowing at the same time AD detection

The proposed model involves co-designing, co-developing, and implementing an intelligent online interactive singing environment that will also enable the detection, monitoring, and follow-up of PLADs using a network of volunteers. The research issues center around the possibilities of integrating the IDSIE into the living environment of PLADs and the satisfaction of caregivers and staff as users. The project relies on adapting and refining already-built systems and known processes with user input. Another challenge lies in transforming the dynamics of CHSLDs to break the isolation of PLADs and reduce the stress of caregivers by adopting new practices through remote social interaction modalities or virtual reality.

The main challenge of this project is to demonstrate the impact of group singing, even at a distance, on mental health. The acceptance and confidence of caregivers and staff in the activity and use of IDSIE will be crucial, as they are the ones who mobilize around PLADs. The results, showing the proof of concept of the IDSIE, will be disseminated to CHSLD users, institutional settings for seniors, researchers in the field, and the general public to demonstrate the lasting impact on the mental health of IDSIE in a CHSLD context, as well as the importance of building an online human network to support social interaction for seniors in CHSLDs.

While integrating group singing into an interactive environment, various challenges might occur. These could span from technical issues and participant engagement to individual responses to the intervention's variability. Each of these obstacles calls for effective strategies to ensure the successful implementation of group singing activities. For instance, technical difficulties might arise. Virtual group singing heavily relies on the appropriate functioning of technology, which includes stable internet connections, efficient audio-visual systems, and the dependable performance of the Intelligent Learning Health Environment. Interruptions or technical glitches could disrupt the activity's flow, potentially reducing its effectiveness and impacting the participants' experience negatively. To mitigate such problems, we plan to use robust and user-friendly technology that is easy to troubleshoot. Technical support will also be readily available during the sessions to address any issues promptly. Furthermore, the IDSIE system will be designed with a focus on reliability and resilience, ensuring consistent service delivery.

Another challenge can be participant engagement. In a virtual environment, securing this can be challenging. Lack of physical presence and difficulties in interpreting social cues may affect the engagement of participants and the overall group dynamic. To address this, we intend to train facilitators on how to engage participants effectively within a virtual setting. This could entail establishing clear communication

norms, encouraging participation through questions and prompts, and employing visual aids or interactive elements to stimulate engagement.

Lastly, we recognize that individual responses to the intervention might be variable. The effects of group singing on Alzheimer's disease symptoms may vary depending on factors like disease severity, individual's previous experiences with singing, and personal preferences. To account for this, the project will implement regular feedback sessions and adjust the intervention based on participant feedback and monitored outcomes. Also, the system will be designed to be flexible and adaptable, accommodating the needs and preferences of individual participants.

Methodology

Designing the workflow is the main focus of this work in order to set a framework to execute the project. Indeed we have to put together various methods, and expertise, so we choose a brainstorming method which is a method design used to generate ideas within a team to generate ideas in order to identify and solve specific problems. problems. method to design the flowchart (Figure 1). So following the method, we first discuss with each researcher and participant, how to grab, define, and ideate, the part they wanted to develop, and which part should be associated with other researchers or participants' wor's in order to obtain a first draft of our workflow process. The workflow also took into consideration the expected outcomes as described below, we used a discussion to list the components that should be taken into consideration and described them as outcomes of the project. So expected results will be able to 1) seniors living in CHSLDs and those who wish to stay at home as long as possible in a healthy and safe manner, 2) caregivers and care providers of seniors living in CHSLDs, particularly those with Alzheimer's disease, 3) researchers in the field looking for alternatives to improve the mental health of seniors, and 4) the general public in the province of Quebec. The methodology led us to consider the flow of activities they could describe using the following steps outlined in Table 1.

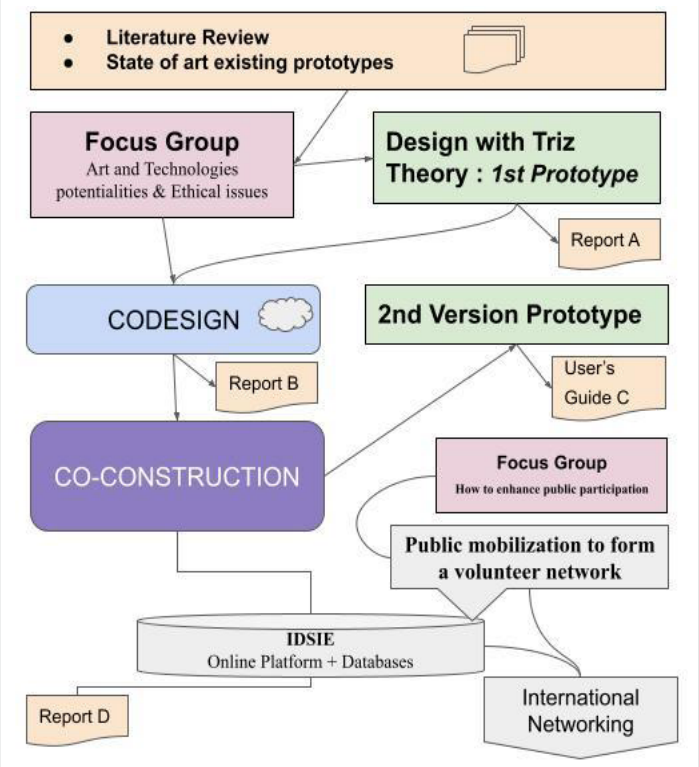

Figure 1: IDSIE Flowchart.

Building upon the premise of using singing as a medium for fostering connections and encouraging physical movement, this project seeks to harness technology to enhance these interactions. In a post-COVID world, the task of conducting these activities remotely introduces a range of technical challenges that this initiative is poised to address. The project stands at the intersection of sensory and technical challenges, leading to associated research questions, all aiming to reshape patient-care organization relationships.

The project structure mirrors this viewpoint. On the sensory front, the act of singing together draws attention to the physicality of participants, the promotion of movement, and the sense of group belonging. Endeavors will be undertaken to incite vocal stimulation or even collective singing [22]. With an aim to assess its impact on patient's mental health and neurophysiology [23,24]. Additionally, research will be conducted to study the benefits of (micro)movement within a singing practice for long-term care residents.

From a technological standpoint, the project proposes that computer-assisted and online creative methods can be augmented by a focus on monitoring AD progression in patients, without being overly intrusive. Thus, AD sign detection specialists (facial expression recognition, voice biometric measurements) and AI experts will collaborate with online voice pedagogy professionals and others striving to make the remote experience more physically engaging. The novelty of this project extends beyond current practices of continuous monitoring for remote patient care [25]. Furthermore, the proposed model integrates caregivers into the developmental process of the IDSIE through a seven-stage action research project.

Research action process description

Our project aims to improve the quality of life in CHSLDs for and with seniors, caregivers, and nursing staff. We believe that setting up relational quality times, virtual spaces to promote non-verbal exchange via singing, relaxation, and methods to lighten the monitoring load via systems will be a contribution to all people living in CHSLDs. Our approach is based on an accompaniment that envisages conditions specific to each one. Obtaining formal consent, through an ethical certificate that will be produced prior to the study.

Table 1: Summary of Research Activities and Objectives for Implementing IDSIE in Long-Term Care Facilities.

Phase	Description
I	Preliminary work involving discussions, prototypes, and literature reviews on:
	1) Impact of voice simulation on neuroelectrical activity
	2) Positive effect of group singing on the mental health of PLADs
	3) Possibilities of implementing this activity online in a relevant and cost-effective way
	* Three team meetings to discuss potentialities and ethical issues
	*** A report (A) for the general public presenting the discussions and conclusions, including graphs and diagrams**
II	Focus group, including the team and knowledge users (caregivers in the CHSLD), established to co-design the IDSIE:
	* Three focus group meetings
	* First meeting introducing available technological systems
	* Next two meetings for experience-sharing regarding various proposals
	*** A report (B) summarizing this phase, setting up protocols**
III	Focus group co-constructing the IDSIE:
	* Integration and adjustment of a continuous detection system and activities deployable on various media (XR to smartphones)
	* Members meet twice a month for six months to suggest amendments
	*** A guide (C) on specific uses in a CHLD context produced**
IV	Development of an online platform, including a database to collect detection results:
	* Ethical design methodology followed to protect user data and secure online presence
	*** A report (D) presenting this phase**
V	**Experimentations: Focus group testing the IDSIE on themselves to validate the relevance of the choices and test possible effectors**
VI	**Public mobilization activity was held to form a volunteer network through social media invitations, targeted campus, and CHSLD announcements, and radio broadcasts**
VII	Focus group reflecting on the best message and means of dissemination for recruiting volunteers for the human network
	*** Presentation of the challenges of IDSIE and the impact of their presence to address senior isolation**
VIII	Team and international collaborators exchanging ideas on the content for a webinar

1. In-depth Reflection on the Relationship between Singing, Body, Remote Exchanges, and Monitoring Ethically of Long-Term Care Residents (Obj.1, with 5 researchers members, 5 seniors citizens and/or their caregivers; 6 meetings): This reflection will be initiated at the beginning of the project and maintained throughout via online exchanges with the entire research team at a sustained pace. Co-design (Obj.1 the entire team, a long-term care facility manager, and caregivers; 4 months): Utilizing focus groups, composed of the entire research team, that included 5 seniors citizens and their caregivers, and informed by the previous exchange (Step #1), the project will gather ideas on what could support long-term care residents, their needs, perceived limits, and the opportunities envisioned towards the use of technologies. The team should then present examples of existing prototypes and outline the ideal vision of the IDSIE with users and the list of constraints using an ethical design process [26,27].

2. Co-construct IDSIE and an Online and Face-to-Face Human Network to Support Caregivers and Long-Term Care Residents through Group Activities (Storytelling, Rhythm, Singing, Exchanges) (Obj.2, the team and the 5 caregivers; 18 months): Building on the co-design stage (Stage #2), IDSIE should be collaboratively developed. Additionally, the project aims to enable the solicitation of volunteers through a secure online network to support and diversify interaction possibilities with long-term care residents. The interaction should be facilitated by preparing semi-assisted system activities. Caregivers and network members can select or create their own story, song, or virtual scenery according to their preferences, as well as encourage residents to participate. The network would also allow caregivers to address challenging issues related to the experiences of long-term care residents and share their experiences through collective Narrative-Based Medicine sessions. An online platform and ethical protocol for online safety (4 months) will be developed to accommodate those interested in supporting caregivers.

3. Development and integration into the IDSIE of the detection system (Obj. 3. months, research team and 2 Caregivers): one group should collaborate to create an expert system using Machine Learning (AI) for detecting signs of Alzheimer's disease progression, framed by ethical design and informed by the research strategy for the patient, as well as steps 1 and 2. The system should remotely measure the condition of long-term care residents and ensure their continuous monitoring during singing activities. Micro-movements of the face, certain voice qualities, and speech are indicators of Alzheimer's disease, but they can be difficult to identify in nonverbal patients. Technological processes for detection have matured for mental health-related measurements, including stress, cognitive load, and cardiac coherence measures. However, specific developments could be needed to adapt these processes to the living environment of long-term care residents. Detection should be done through continuous sounds, and non-invasive face/voice/biometric sensors when using IDSIE. The monitoring effort is a crucial task for long-term care staff and requires constant attention. Implementing IDSIE will not replace all these efforts but could lighten the workload. Data protection, residents' comfort, and respect for caregivers' constraints will be central concerns in an ethical design approach. The detection study should initially produce three separate systems: 1- voice, 2- face, and

3- biometrics, which will be integrated into IDSIE during the first and second years, with adjustments made in the third year.

4. Co-Construction of Space for Exchanges and Online Group Activities (Obj. 2 and 3; research team and 5 Caregivers; 18 months): The co-constructed detection systems should be used for self-assessment (see point 7), providing caregivers multiple avenues to engage in activities and involve long-term care residents. The goal is to enable caregivers to create positive activities for themselves and residents, improving time management and living space. The virtual activity space should integrate (a) relaxation areas in simulated natural environments; (b) virtual spaces for staging; (c) a hybrid space (virtual and present) for Narrative-based Medicine (NBM) to narrate caregivers' perceived difficulties; and (d) a hybrid space for personalized support touching on spiritual aspects according to the previously mentioned approach. NBM is recognized in healthcare settings for providing psychological support. These components will enable the exploration of various emotional situations, supported by sensory effectors to amplify the desired corporeal effect. The project should rely on the vicarious effect that occurs when users personify a virtual component, allowing better technology adoption, and on stress reduction when caregivers can self-evaluate. Over three years, three phases will be dedicated to 1- study, 2- implementation of activities in the interface with the integration of semi-automated systems for user support, and 3- adjustments in the long-term care context. The challenge of steps 4 and 5 will be to determine if group singing provides health benefits even when conducted remotely.

Intervention design

1. Validation, experimentation, and beta testing (Obj. 3; research team and 5 Caregivers): Caregivers, the team, and collaborators will validate the resulting measures from the integration of all systems, the organization of human network interventions within the IDSIE, and it's detection functionalities and group activities. This should be done through bimonthly sessions over six months during the 2nd year, followed by adjustments during the final year when implemented in the long-term care facilities. The focus should be on ensuring a simple, intuitive, and adaptive system for caregivers and long-term care residents, as well as establishing the effectiveness of detecting signs of discomfort and pain in PLADs.

a) In addition to the initial Focus Group members, 10 other caregivers will be recruited. Recruitment will take place in CHSLDs, in particular without being exclusive to the one that will host the project. Each participant should use the IDSIE, equipped with a real-time detection system, for 30-minute sessions. The credibility of the corporeal experience should then be assessed through biometric measurements of the study's caregivers. At the end of each session, participants should answer a questionnaire on body effects, usability, and satisfaction. The experimental phase should collect real-time biometric information (EEG, ECG, EMG) to detect and interpret Alzheimer's signs and assess stress levels, mental load, and cardiac coherence. A database including face/voice movements will be established and will integrate a control group. Then, the IDSIE should be used by three caregiver-resident pairs in their long-term care settings for eight weeks. To measure caregiver satisfaction, usage frequency, and duration should be recorded. Regarding possible changes in residents' conditions during the study, a Neuropsychiatric Inventory (NPI) questionnaire will be conducted before and after the eight weeks with nursing staff, and a reduced version (NPI-R) with caregivers. A separate, specific study (conducted over one day at Laval University Hospital Center) should measure the impact of group singing activities on brain activity using EEG for five PLADs to produce a guide on the most promising vocal stimulation modalities for caregivers. Particular attention should be paid to IDSIE's usability and ethical precautions to ensure online security, including data protection.

2. Implementation of a prediction system (Obj. 3, 6 months; research team): The team should then analyze data according to participants' gender, age, and specific movements (vocal, micro-facial movements) and develop a prediction system using AI to anticipate and support the user.

3. Results and dissemination (Year 3, 4 months; research team): The team should finally publish in-person and online communications targeting seniors, senior institutions, and the general public. Online group singing activities should be launched to promote the project and invite the general public to experience the group singing process for themselves. A webinar, presented on a dedicated project website with videos documenting the project, should then be made available online.

Expected results and expected benefits

The proposed project acknowledges that the successful transformation of health services provided in long-term care facilities, particularly concerning mental health, relies not only on the advantages of a socio-economic strategy and a remote monitoring solution but also on the active participation of family caregivers in the co-design and co-construction process. The approach offers a comprehensive understanding of the needs of family caregivers, nursing staff and their older adult patients with cognitive decline (LDCs) and enables better integration of potential solutions that instill confidence, foster understanding, and demonstrate their potential.

A key benefit of this project will be the development of an affordable, easy-to-use IDSIE system that could potentially be employed in seniors' homes for early detection and maintenance of mental health through group singing. The project also aims to contribute to the crucial transformation efforts of CHSLDs, addressing the growing population and

expansion of Alzheimer's disease. Additionally, our project unites experts who are exploring alternative, interdisciplinary solutions to support new practices informed by neuroscience. By establishing an online human network, which advocates public participation in CHSLD, or remote participation, we would like to find alternative human resources to fight in a secure manner against the loneliness of seniors.

Ethical considerations of data collection

The ethical considerations of data collection, particularly when it pertains to early indicators of disease such as Alzheimer's, are indeed a delicate subject. It raises questions of consent, privacy, and potential stigmatization, particularly in a context where those involved may not be aware that such data is being collected. One must balance the potential benefits of early detection and intervention against the possible harm caused by unwarranted invasion of privacy or the undue stress of knowing that one may be at risk for a disease. In this context, the ethical solution hinges on transparency, informed consent, and participant autonomy.

Firstly, full transparency in the intent and usage of data collection should be the cornerstone of our approach. Participants and their families should be provided with clear information about what data will be collected, why, and how it will be used. This includes explaining the potential for detecting early signs of Alzheimer's and the advantages of such detection, such as early intervention and better management of the disease. Secondly, we advocate for informed consent. After receiving comprehensive information, participants should have the choice to participate in the program. This consent should be ongoing, meaning participants have the right to withdraw their consent and discontinue their participation at any time.

Lastly, recognizing the concern that the potential for detecting early signs of Alzheimer's may deter some individuals from participating, it might be prudent to offer multiple levels of involvement. Participants could choose to engage with the program purely for its social and mental health benefits, without any data collection involved. Alternatively, they could opt for a level of participation that includes data collection and analysis for disease progression tracking [28-30].

Conclusion

The project aims to revolutionize care using ethical design and support provided to residents with Alzheimer's disease and their caregivers in long-term care facilities. By developing an affordable, user-friendly IDSIE for early detection and maintenance of mental health through group singing, the project addresses a pressing need in the current healthcare landscape. Through a co-design and co-construction approach, the project ensures that the perspectives and needs of family caregivers, nursing staff, and residents with cognitive decline are considered, leading to more effective and sustainable solutions.

By bringing together experts from diverse fields and fostering interdisciplinary collaboration, this project holds promise to substantially impact the lives of individuals with Alzheimer's disease and their caregivers. The creation of an online human network, aligned with the Interministerial Mental Health Action Plan, serves the broader objective of incorporating digital interventions into mental health services and enhancing collective well-being. With its innovative approach, the project proposes exciting deliverables, including the IDSIE system, an extensive study of its effects, guides for vocal stimulation, and a supportive online human and technological network.

This online human support aims to inspire the public to participate in combating loneliness in seniors and equipping the general population with tools to safely address concerns raised during the COVID lockdown. These outcomes could revolutionize mental health care in CHSLDs, ultimately benefitting seniors with AD and their caregivers. The research team recommends implementing the proposed stages and a continued evaluation of the initiative's effectiveness. A regular refinement of the outlined strategies should also be considered to ensure that the system remains adaptable and responsive to the evolving needs of the Alzheimer's community. By doing so, this project could have a substantial, long-lasting impact on the lives of those affected by AD and contribute to the ongoing efforts to enhance mental health care in CHSLDs and beyond.

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