Research Project Protocol

TITLE	Non-Randomized Clinical Trial on Cognitive Stimulation with Virtual Reality in Patients with Mild Cognitive Impairment Acronym -**RVEC-DCL**
PROTOCOL CODE	**REF.CEI PI-24-210**
PROSECUTOR	Badalona Care Services

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SUBSTANTIAL MODIFICATIONS TO THE PROTOCOL

Date of modification	Modified section	Justification for the change
16-10-2024	Schedule (Work Plan for Conducting the Study) Sample - Selection Period	The adjustment to the dates is due to organizational reasons, specifically to extend the recruitment and participation period, which will allow for a more representative sample. This change will improve the ability to assess the results more reliably and extrapolate them.

1. PROTOCOL SUMMARY

Title and subtitles, version and date of the protocol	Non-Randomized Clinical Trial on Cognitive Stimulation with Virtual Reality in Patients with Mild Cognitive Impairment Acronym -**RVEC-DCL**
Name and surname of the main author and the organization they work for	José Ferrer Costa. Badalona Assistance Services.
Justification and context	
Hypothesis	
Goals	
Design	
Population	
Total number of subjects	
Variables	
Data source	
Medicinal product or medical device subject to evaluation (where applicable)	
Data analysis	
Stages and schedule	

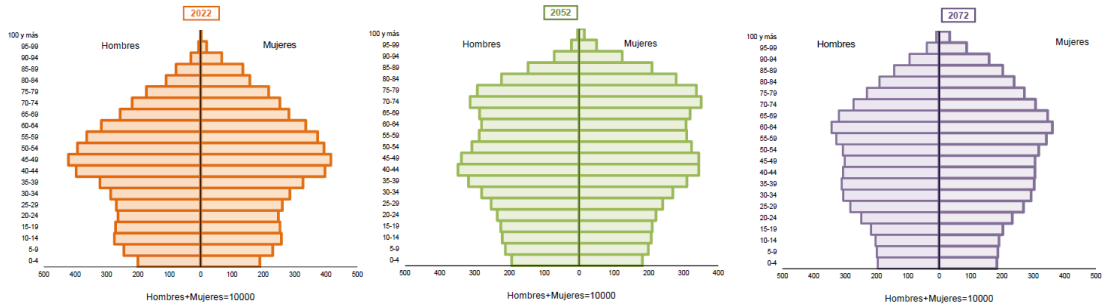
1. BACKGROUND AND JUSTIFICATION

The aging of the population in Spain is reaching unprecedented levels. The most recent data from the National Institute of Statistics (INE) and the Ministry of Health show an accelerated aging of the Spanish population, and associated with this, a growing prevalence of cognitive impairment and dementia, which represents a significant challenge for public health.

In 2022, the INE reported an aging index of 133.5%, with 133 people over 64 years of age for every 100 under 16. This phenomenon, which has shown the greatest growth since 1999, is projected to continue increasing, reaching 30.4% of the total population in 2050. Furthermore, the centenarian population (people aged 100 or older) will increase from 14,287 currently to 226,932 by the end of the projected period in 2072 (Figure 1).

Figure 1 - Source

Pirámides de población de España (años 2022, 2052 y 2072)



The increasing prevalence of cognitive decline and dementias, such as Alzheimer's disease, presents a significant challenge to global public health, with a rapid intensification coinciding with population aging (United Nations, 2015). Alzheimer's disease currently affects 5% of people over 65 in Spain, with approximately 800,000 diagnosed. However, due to population aging, the prevalence is projected to double in the coming decades, affecting more than 41 out of every 1,000 people by 2050.

The impairment of memory, attention, and executive functions that characterizes dementia substantially impacts the quality of life of patients, also placing a considerable burden on caregivers and health systems.

The term "dementia" encompasses a variety of diseases and conditions that lead to cognitive decline, affecting memory, language, problem-solving, planning, abstract reasoning, and other cognitive abilities, consequently impairing a person's capacity to perform daily activities. This global issue affects more than 55 million people, with approximately 10 million new cases diagnosed annually (World Health Organization, 2023). This steady increase underscores the need for the design, implementation, and evaluation of innovative therapeutic strategies to support the care and management of individuals with dementia and related conditions.

The Comprehensive Plan for Alzheimer's and Other Dementias 2019-2023 of the Ministry of Health, Consumer Affairs and Social Welfare underscores the importance of cognitive rehabilitation programs and the use of technology in managing these diseases. This plan recognizes the need to promote cognitive activity and stimulation programs, adapted to the neuropsychological characteristics of the different stages of the disease, and proposes prioritizing these programs from the initial phases. Furthermore, it highlights the importance of defining and standardizing the appropriate professional profile for the planning and implementation of these programs.

This plan also identifies a gap between professionals' perception of the usefulness of non-pharmacological therapies and their actual prescription, as well as a significant lack of awareness among users regarding the existence and availability of these treatments. Therefore, it highlights the need to improve the dissemination of information and training for both professionals and patients and caregivers about the available cognitive rehabilitation options.

In this context, virtual reality (VR) has emerged as a promising tool for cognitive stimulation in individuals with cognitive impairment. VR offers an immersive and engaging environment that allows for the recreation of everyday situations in a safe and controlled space. Several studies have demonstrated that VR can significantly improve cognitive skills and reduce interference in people with mild cognitive impairment (MCI). Furthermore, a recent meta-analysis (Perra A. et al., 2023) confirms the positive impact of VR-based cognitive rehabilitation programs, demonstrating improvements in cognitive function, daily functioning, depressive symptoms, and quality of life.What

JUSTIFICATION
This protocol marks the expansion of the research carried out in the pilot project “Development and evaluation of virtual reality experiences for cognitive stimulation at the El Carme Sociosanitary Center of Badalona Healthcare Services (BSA)” assessed and approved by the CEI HUGTiP with protocol code PI-23-195. The protocol for the pilot study is registered inhttps://clinicaltrials.gov/study/NCT06155721.

Justification of the Study
The next phase of the clinical trial is based on the positive results obtained in our pilot study, which have been presented in prominent academic forums, reaffirming the viability and potential of virtual reality (VR) as a cognitive rehabilitation tool for patients with mild cognitive impairment (MCI).

Results of the Pilot Study
1- Integration of VR in the Rehabilitation of Mild Cognitive Impairment
Authors: José Ferrer Costa, Maria-José Ciudad, Maribel González Abad, José Luis Rodríguez García, Julisa Cortes.
Event: Conference "A Metaverse for the Good", organized by EventLab of the University of Barcelona.
Date and Place: April 10, 2024, Barcelona.
Abstract: This poster presented a customized VR program that includes interactive exercises and 360-degree videos, designed to improve cognitive function and foster social interaction. Preliminary results indicated high acceptance and satisfaction among participants, as well as a

positive perception from healthcare professionals regarding the ease of integrating the program into daily clinical practice.

2- Impact of Virtual Reality Interventions on Cognitive Functions in Mild Cognitive Impairment: A Pilot Study
Authors: M.J. Ciudad, J. Ferrer, M. González-Abad, J.L. Rodriguez-García.
Event: 64th Congress of the Spanish Society of Geriatrics and Gerontology (SEGG).
Date and Place: June 27, 2024, Malaga.
Abstract: This poster highlighted the assessment of cognitive functions using standardized tests (MMSE, MoCA, Digit Span Forward and Backward, TMTA, and SDMT) before and after VR intervention. Although no statistically significant improvements were observed in most tests, a slight improvement was recorded in the TMTA. Furthermore, VR was found to be well-tolerated by the participants, with no evidence of a decline in their cognitive abilities.

These preliminary results suggest that VR could be an effective and well-accepted tool for cognitive stimulation in patients with mild cognitive impairment (MCI). This new study will allow for a more comprehensive evaluation of VR as a therapeutic tool, with the potential to innovate cognitive rehabilitation for patients with MCI.

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3. HYPOTHESIS OR STUDY QUESTION

Main Hypothesis:

Adding a cognitive stimulation program using virtual reality (VR) to conventional intervention will significantly improve the cognitive functions (attention, memory, etc.) of patients with mild cognitive impairment (MCI), compared to those who only receive conventional cognitive stimulation.

Secondary Hypotheses:

1. Patients in the VR intervention group will show greater adherence to the cognitive stimulation program compared to the control group.
2. Healthcare professionals will perceive VR as an applicable and beneficial tool in the clinical practice of cognitive rehabilitation.
3. The RV intervention will not have significant adverse effects and will be well tolerated by patients.
4. The VR intervention will improve the autonomy and independence of the participants.

4. GOALS

- **Main Objective:**To evaluate the improvement in cognitive functions (attention and memory) of patients with MCI after the application of a cognitive stimulation program using virtual reality, compared to a conventional intervention.

- **Secondary Objectives:**
  - To evaluate patients' perception of the usefulness and motivation of VR interventions compared to conventional interventions.
  - To measure adherence to the cognitive stimulation program in the VR intervention group compared to the control group.
  - To collect and analyze the perceptions of healthcare professionals regarding the integration of VR into daily clinical practice and its impact on the quality of patient care.
  - Identify and evaluate any adverse effects associated with the use of VR in cognitive intervention and the mitigation strategies employed.

5. RESEARCH METHODS

5.1 Type of study

Non-randomized interventional controlled experimental clinical trial.

5.2 Design

The study design is prospective and non-randomized, with two parallel intervention groups. The research is structured to compare the effects of an innovative intervention using virtual reality (VR) for cognitive stimulation versus a control group receiving a conventional intervention without VR.

5.3 Sample

Source Population

The study population will consist of people diagnosed with Mild Cognitive Impairment who regularly attend the cognitive stimulation program at the Psychogeriatric Day Hospital of the El Carme Intermediate Care Center of Badalona Serveis Assistencials.

Selection Location: Participants will be recruited from the El Carme Intermediate Care Center in Badalona, which offers regular cognitive stimulation sessions.

Selection Period: Participant selection will take place from September 2024 to September 2025, with the study scheduled to begin immediately after the recruitment and consent process is completed.

Inclusion criteria:

- Participants must be at least 60 years old, with no maximum age limit.
- Participants must be classified as having mild cognitive impairment with an MMSE score > 20.
- Participants must currently be attending cognitive stimulation sessions at the CSSC Day Hospital.
- Participants must be able to give their informed consent or, in case of incapacity, the consent of their legal representative must be obtained.

Exclusion criteria

- Patients with a serious or unstable illness that may interfere with their participation in the study.
- Patients with severe psychiatric disorders, such as psychotic disorders, delusions, or hallucinations, which may be exacerbated by the use of virtual reality.
- Patients with severe visual impairments that would prevent the use of virtual reality.
- The presence of eye diseases that cause blurred vision that cannot be corrected with contact lenses or glasses.
- Presence of auditory pathologies that cause a significant decrease in hearing without hearing aids.
- High sensitivity to motion sickness.
- Epileptic subject.
- Patients who are unable or unwilling to give their informed consent.

Withdrawal criteria

Withdrawal criteria will include the occurrence of health problems that may interfere with continued participation in the study, or withdrawal of consent by the participant.

Sampling Type

Non-Probabilistic Sequential All patients who meet the inclusion criteria and do not meet any of the exclusion criteria will be invited to participate, until the desired number of participants is reached.

Study Groups:

- Experimental Group (VR): Composed of patients who attend cognitive stimulation sessions on Mondays and Wednesdays. This group will receive the additional virtual reality intervention along with conventional computer-based cognitive therapy.
- Control Group: Composed of patients who attend sessions on Tuesdays and Thursdays. This group will continue with conventional cognitive therapy without the addition of virtual reality.

The Monday-Wednesday and Tuesday-Thursday groups have been determined to be comparable and similar in composition in terms of demographic characteristics and level of cognitive impairment, providing an equitable basis for comparing outcomes between the experimental and control groups.

Intervention

Sessions:

The 12 sessions will take place on Mondays and Wednesdays, at the same time as the participants' scheduled appointments for the conventional cognitive stimulation program

at the CSSC Day Hospital. The sessions are 45 minutes long, with 15 minutes dedicated to VR exercises.

Equipment and Technology:
We use Meta Quest 2 or 3 glasses and their hand-tracking technology, which allows for a more immersive and less complicated experience for participants, especially those with MCI.

Virtual Reality Experiences Developed:

A) Interactive Cognitive Stimulation Exercises (Declarative Memory, Executive Functions):

Developed jointly by the VR teams at BSA and Reality Telling, following the researchers' guidelines, three types of sequential interactive exercises have been created:

Step 1 - Make a Purchase at the Supermarket:
- Scenario: Virtual supermarket.
- Avatar: An animated avatar greets the participant and provides instructions.
- Objective: To select ingredients to make a potato omelet or gazpacho.
- Interaction: Participants use hand-tracking technology to grab products and place them in a virtual cart.
- Feedback: A success or failure audio message is emitted based on the product selection.

Step 2 - Pay for the Purchase:
- Setting: Checkout area of the virtual supermarket.
- Avatar: An animated avatar greets the participant and provides instructions.
- Objective: To pay the exact amount for the selected products.
- Interaction: Select 3D models of banknotes and coins to reach the correct sum.
- Feedback: An avatar and audio provide confirmation or correction.

Step 3 - Order the Recipe Steps:
- Setting: Virtual kitchen.
- Avatar: An animated avatar greets the participant and provides instructions.
- Objective: To organize photos of the recipe steps.
- Interaction: Drag and drop photos onto a numbered panel.
- Feedback: Avatar confirmation.

Scenario details:
- Step 1: Make a purchase at the supermarket. Upon entering the supermarket, an animated avatar greets the participant and explains that they must select the correct products to make a Spanish omelet (tortilla de patatas) or gazpacho. The products are arranged on a shelf; some are correct, others incorrect. Participants must select the products by picking them up and placing them in the shopping cart. When the products are placed in the cart, the program recognizes them as correct or incorrect. If it is a correct product, an audio message plays, and the product remains in the cart. If it is

incorrect, an audio message plays explaining that the product is incorrect, and the item is automatically returned to the shelf.

- Step 2: Pay for the purchase. In this exercise, the avatar explains that the cash register is not working and asks that the purchase be paid with the exact amount. We have created 3D models of money and coins that are arranged next to the cash register. The total amount of money is added up on a screen as each model is selected. If the desired total is exceeded, an audio message plays explaining that the player should try again, and the sum resets to zero. When the desired amount is reached, a congratulatory audio message plays.
- Step 3: Order the recipe steps. In a kitchen, an animated avatar explains the exercise. We have photos of the steps in the recipe for a tortilla or gazpacho, and a grid with 6 numbered spaces. The goal is to order the photos of the steps, placing each one in the numbered grid in the correct order.

B) Cognitive Stimulation with Videos (Attention and Episodic Memory):

- Video Descriptions: 360-degree videos were filmed in familiar locations around Badalona to maximize familiarity and comfort for participants, most of whom are local residents. The videos are of two types: static, where the perspective remains constant; and dynamic, simulating a slow walk.
- Real-time tracking technology: An application will be used that allows the therapist to follow the video in real time on a tablet. This will facilitate interaction between the therapist and the participant, improving the effectiveness of cognitive stimulation.
- List of Videos:
    - Video 1 (6:24) “Plaça de la Vila Badalona”. Static video in front of the Badalona town hall.
    - Video 2 (5:00) “Carrer de Mar Badalona”. Moving video walking slowly along the main pedestrian street of Badalona.
    - Video 3 (3:06) “Pas soterrani cap a la platja”. Moving, walking slowly from the end of Calle de Mar to the beach.
    - Video 4 (2:00) “Walking along the Passeig Maritim Badalona - Part 1”. In motion walking at the beginning of the Passeig Maritim in Badalona.
    - Video 5 (2:00) “Walking along the Passeig Maritim Badalona - Part 2”. In motion walking along the Passeig Maritim.
    - Video 6 (3:30) “Walking along the Passeig Maritim Badalona - Part 3”. In motion walking along the Passeig Maritim from Anis del Mono to the Pont del Petroli.
    - Video 7 (5:00) “You see the Pont del Petroli Badalona”. Static on a balcony overlooking the sea and the Pont del Petroli.
    - Video 8 (5:00) “Coco Beach Badalona”. Static on the Promenade.
- Cognitive Stimulation Procedure with Videos:

- Method: Real-time visual-verbal stimulation performed by a researcher who accompanies and guides the dynamics of the session.
- Activity: During the viewing of the videos, the researcher accompanying the session asks the participants to focus on specific elements, such as whether they recognize the place, how many bicycles have passed, whether they have seen any dogs, etc.

- Questioning: At the beginning of the session, the type of visualization that will be carried out will be introduced (*"Next, you are going to watch a video of a plaza in which you will see different scenes. Pay attention."*.
  During the viewing of the scenes, questions will be asked regarding the environment and the elements that appear to encourage attention.*("Do you recognize the square? Have you ever been here? What is its name? What are you looking at? Look very closely at all the details.").*
  At the end of each video, open-ended and multiple-choice questions are asked.*("Have you seen any animals? How many dogs have you seen pass by, 2 or 5?, …")*to evaluate attention and memory with respect to the elements shown.
- Objectives: The objective of this intervention is to stimulate and evaluate aspects of cognitive function such as attention (focused, sustained and alternating), memory and visuospatial function (immediate, working, episodic, semantic, spatial orientation, visual memory).
- Participant Feedback: At the end of the session, feedback will be collected from participants to improve future interactions of the exercise.

C) Integration of the Virtuleap Platform into the Study

Data Connection and Security:
For the Virtuleap intervention in our study, we will establish a secure connection with the Virtuleap server. This connection ensures that no biometric data is collected from participants, focusing exclusively on the responses provided during the exercises. This measure guarantees the privacy and security of participants' personal information, while allowing for detailed monitoring of cognitive performance without compromising user integrity.

Performance Monitoring:
Each participant will be identified with a unique code in each session, allowing for precise tracking of their progress and performance in the various cognitive activities. This system facilitates continuous and reliable monitoring, maintaining the confidentiality and objectivity necessary for the study.

Virtuleap Games and Tools Library:
Virtuleap offers a variety of 15 games based on validated neuropsychological tools, designed to train up to seven different cognitive skills. These games are available for use in a controlled and secure environment within the studio, ensuring that each game addresses specific aspects of cognition such as memory, attention, and problem-solving.

Organizational and Remote Control Tools:

Organizational Dashboard: A web-based dashboard that allows researchers to access and manage study participant data. This dashboard is essential for monitoring progress and adapting interventions in real time.
Remote Control: This tool allows an authorized person to guide the user within the Virtuleap application, thus optimizing the experience for those participants with less digital literacy.
Survey Engine: Allows you to incorporate questionnaires and surveys within the Virtuleap application, which is useful for collecting additional data on the user experience and their response to the intervention.

Application in the Study:
Integrating Virtuleap into our study will allow us to provide a series of cognitively demanding tasks in an immersive environment, which could increase engagement and the effectiveness of cognitive training. Furthermore, the ability to monitor and adapt cognitive training in real time based on individual performance data ensures that participants are continuously challenged at an appropriate level, fostering optimal cognitive development.

This comprehensive approach not only facilitates effective intervention but also improves our ability to accurately assess the impact of virtual reality on cognitive rehabilitation, offering a valuable contribution to the field of treatment and research of mild cognitive impairment.

5.4 Study variables

The study variables will be the same as those used in the pilot study, using the same scales and adding in this case the A-IADL scale to assess the functionality of the participants.

5.4.1 Outcome, exposure, or effect variables

Main Outcome Variables:

Cognitive function measured through standardized neuropsychological tests:

- Specific to attention, executive function and processing speed (Digits, TMT [appendix 3], SDMT [appendix 4]).

Tests of general cognitive function:

- Montreal Cognitive Assessment (MoCA) [anexo 5]
- Mini-Mental State Examination (MMSE) [anexo 6]

Functional activity test:

- Lawton-Brody [annex 7]

The assessments will be carried out before the start of the training program and one week later, after the intervention has ended.

Secondary Outcome Variables:

Acceptability and usability of VR exercises: This will be measured using a user satisfaction questionnaire and the System Usability Scale for patients and professionals (SUS). [appendices 8 - 10]

They will be administered after the last VR session.

5.4.2 Other variables

- Age
- Sex
- Etiology of cognitive impairment

5.5 Study evaluations:

Visit	Procedures
Selection visit (Pre-study)	Informed consent, collection of demographic data and pre-intervention cognitive function variables
Visit 1 (Sessions 1 to 12)	Start of VR training sessions
Visit 2 (At the end of Session 12)	Completion of VR training sessions, questionnaires on post-intervention cognitive function variables, satisfaction and usability.

5.6 Sample size

Justification of Sample Size

In this study, the sample size will be determined by the current availability of patients attending the cognitive stimulation program at the El Carme Intermediate Care Center (CSSC). There are approximately 20 patients in each group (Monday-Wednesday and Tuesday-Thursday), resulting in a total of approximately 40 patients available for the study during the study period.

Justification for Convenience Sample Size

The sample size of 20 patients per group is a convenience sample size based on participant availability at the CSSC. Although this sample size is smaller than the ideal size calculated to achieve high statistical power, it is still adequate for conducting a preliminary analysis and obtaining exploratory data that can provide a basis for larger future studies.

Additional Considerations

- **Feasibility and Resources**The sample size of 40 patients is manageable and appropriate given the resources and logistical capacity available at the CSSC. This approach allows for a practical and controlled implementation of the study without compromising the quality of the intervention and follow-up.
- **Statistical Power and Interpretation**With a smaller sample size, the statistical power of the study may be lower, and caution should be exercised when interpreting the results. However, the findings obtained may offer valuable preliminary information on the effectiveness of virtual reality in cognitive rehabilitation and serve as a basis for larger, more powerful studies in the future.
- **Hypothesis Development and Exploratory Evaluation**This study will help develop and refine hypotheses for future research. Despite limitations in sample size, the results are expected to provide important insights into the feasibility and potential benefits of virtual reality intervention.

5.7 Statistical analysis

The data collected during the study will be analyzed using statistical methods appropriate for each type of variable. All analyses will be performed using SPSS 27.0 statistical software. Hypotheses will be evaluated at a significance level of $p < 0.05$ (95% confidence level).

Acceptability and usability: The scores obtained on the System Usability Scale (SUS) will be analyzed descriptively to provide an overall measure of the acceptability and usability of the VR intervention.

Cognitive assessment: Depending on the normality of the variables, statistical tests comparing scores will be applied (parametric Student's T or non-parametric Wilcoxon (in the case of failure to comply with the assumption of normality).

Demographic and clinical variables: Multiple correlation and regression analyses will be used to examine the relationships between demographic and clinical variables (age, gender, etiology) and changes in acceptability, usability, cognitive function, and quality of life.

5.8 Limitationsand Mitigation Strategies

Design Limitations

1. ***Reduced Sample Size****:*
    - ***Description****The study will include approximately 40 patients, limiting the statistical power.*
    - ***Mitigation Strategy****: Use of appropriate statistical analyses for small samples and focus on obtaining preliminary data that can guide future, larger studies.*
2. ***Non-Randomized Assignment****:*
    - ***Description****Group assignments are based on days of attendance.*
    - ***Mitigation Strategy****: Control and statistically adjust for possible baseline differences between groups in demographic and clinical variables.*
3. ***Study Duration****:*
    - ***Description****The intervention will last 12 weeks.*
    - ***Mitigation Strategy****: Conducting post-intervention follow-up to assess the persistence of effects in the medium term and to consider future longitudinal studies.*

Limitations of the Information Source

1. ***Reliability of Participant Responses****:*
    - ***Description****: Possible memory biases or social desirability biases.*
    - ***Mitigation Strategy****Clear and consistent instructions for participants and cross-validation of information collected through multiple methods (questionnaires and direct observation).*
2. ***Variety in the Technical Ability of the Participants****:*
    - ***Description****: Differences in familiarity and technical ability to use VR.*
    - ***Mitigation Strategy****Initial training and ongoing support for participants, plus the use of the remote control tool to facilitate guidance during the sessions.*

Limitations of Analysis Methods

1. ***Limited Statistical Analysis****:*

- ***Description**: Limitations in the ability to perform complex analyses with a small sample size.*
- ***Mitigation Strategy**: Application of robust statistical methods for small samples and focus on descriptive results and observed trends, rather than exclusive reliance on statistical inferences.*

2. ***Generalization of Results**:*
   - ***Description**The results may not be generalizable to other populations.*
   - ***Mitigation Strategy**Detailed documentation of the study population and context, and suggestions for replicating the study in different settings and with more diverse samples in future research.*

6. SOURCES FOR OBTAINING AND MANAGING DATA

6.1 Data source

Data collection for this study will be carried out using primary sources. The data will be obtained directly from the participants:

The acceptability and usability of the VR exercises will be measured through questionnaires that participants will complete after each VR session.

Cognitive function and quality of life will be measured through standardized tests that participants will complete before, during, and after the VR training program.

Variables such as age, gender, and type of cognitive impairment will be collected through interviews and medical records.

6.2 Data management and quality control

Data will be recorded using standardized spreadsheet templates to ensure consistency in data collection. Each participant's data will be recorded using a unique identification code to maintain confidentiality.

To ensure data security, the data will be stored in a secure folder within the BSA intranet. Access to this folder will be restricted to the study's principal investigators to maintain data privacy and prevent unauthorized manipulation.

Finally, before data analysis, the data will be cleaned and reviewed to detect and correct any inconsistencies or errors. This stage will ensure that the results of the statistical analysis are based on accurate and valid data.

7. PROTECTION OF PERSONS UNDER INVESTIGATION

7.1 Benefit-risk assessment for research subjects

This interventional study uses virtual reality (VR) for cognitive stimulation in patients with cognitive impairment. The following potential risks and benefits for participants have been identified, along with specific mitigation strategies for the identified risks.

Risks and Mitigation Strategies:

1. Side effects of VR: Some patients may experience dizziness or disorientation with VR. To mitigate this risk, VR experiences will be designed to be static or involve gentle movement, and the technology will be introduced gradually. Side effects will be carefully monitored, especially in patients with conditions that may increase the risk.

2. Patient Acceptance: Since VR is a relatively new technology, it can be intimidating for some patients. To overcome this barrier, the potential benefits of VR will be effectively communicated, and patient concerns will be proactively addressed. Engaging healthcare staff throughout the process can improve patient acceptance and adherence.

3- Technical Issues: Like any technology, VR can face technical issues such as hardware or software failures, or internet connectivity problems. To mitigate this risk, backup equipment will be available, and healthcare staff will receive appropriate training on how to operate the VR equipment. Fast and efficient technical support will also be guaranteed to resolve any issues that may arise.

4- Technical Issues: Like any technology, VR can face technical issues such as hardware or software failures, or internet connectivity problems. To mitigate this risk, backup equipment will be available, and healthcare staff will receive appropriate training on how to operate the VR equipment. Fast and efficient technical support will also be guaranteed to resolve any issues that may arise.

5- Exclusion of certain patients: Some patients may not be able to participate due to severe cognitive impairment, dizziness, certain visual disabilities, or other health conditions, which could potentially lead to feelings of exclusion or frustration. To mitigate this risk, communication with patients regarding the limitations on who can participate in the study will be clear, explaining the health and safety reasons. For those patients who cannot participate, alternative activities or interventions will be explored.

6- Physical safety: There is a risk that patients may trip or fall during VR use due to spatial disorientation. To mitigate this risk, patients will be seated during VR sessions and closely supervised by healthcare staff to ensure their safety. In addition, the area around the patient will be kept free of obstacles.

7- Withdrawal effect: If the VR tool is withdrawn after the study concludes, participating patients may show less interest in continuing with the conventional cognitive stimulation program. To mitigate this risk, if the study results are positive and demonstrate significant benefits for patients, a commitment will be made to maintain this tool's use within the cognitive stimulation program.

Benefits

1- Cognitive stimulation: VR offers an interactive and engaging medium for cognitive stimulation, which can be more motivating and attractive to patients than traditional therapies.

2- Improved emotional well-being: Patients may experience an improvement in their emotional well-being by participating in immersive VR experiences, especially if the sessions are designed to be enjoyable and fun.

3- Contribution to research: Patients will participate in a study that may contribute to improving the understanding and treatment of cognitive impairment.

To ensure the safety and comfort of participants, healthcare staff will receive comprehensive training in the use of VR. All necessary precautions will be taken to minimize risks, and participants will be closely monitored for any side effects. It is hoped that participation in the study will have a positive impact on participants' cognition and emotional well-being and contribute to research in this field.

7.2 Information to subjects and informed consent

The research team is committed to ensuring that all potential participants receive clear, complete, and understandable information about the study. This information will include details about the purpose of the research, the procedures that will be carried out, the potential benefits and risks, and the handling of the confidentiality of personal information and study results.

To achieve this objective, the following methods will be used:

Informed Consent Document: An Informed Consent document has been prepared and will be provided to each potential participant. This document will include detailed information about the study, including its purpose, procedures, and potential risks and benefits. The document will also emphasize that participation in the study is entirely voluntary, and that the individual has the right to withdraw from the study at any time without any repercussions on their medical care.

Participant Information Sheet: Potential participants will be provided with an Information Sheet, which will supplement the Informed Consent document, offering a summary of key study information in an easy-to-understand format.

Information Sessions: During meetings with potential participants, they will be given the opportunity to ask questions and discuss any concerns they may have. Before obtaining consent, it will be verified that the participant has fully understood the information provided. To facilitate understanding, all aspects of the study will be explained using simple and accessible language.

Legal Representative Consent: In cases of patients with moderate cognitive impairment who may have difficulty understanding the information provided or giving their consent, informed consent will be requested from their legal representative. The legal

representative will be present during the explanation of the information and the obtaining of consent.

The principle of participant autonomy will be respected at all times. No individual will be included in the study without having provided valid informed consent, either directly or through their legal representative. A record of the consent process will be maintained for each participant to ensure transparency and accountability.

7.3 Confidentiality and data protection

This study fully complies with Spanish and European data protection regulations, including Organic Law 3/2018, of December 5, on the Protection of Personal Data and the guarantee of digital rights, as well as Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

Data Origin

- **Direct Patient Data**The data will be obtained directly from patients through questionnaires and cognitive assessments conducted during the intervention sessions.
- **Medical Records**Relevant demographic and clinical data will be collected from patients' medical records.
- **Virtuleap Platform**Performance data for the VR exercises will be collected through the Virtuleap platform. This data will be coded and pseudonymized, ensuring that the participants' identities are not revealed.

Consent for Data Processing

Informed consent will be obtained from all patients for the processing of their personal data. This data will be pseudonymized to protect patient identity, assigning a unique code to each participant that will be used in place of personally identifiable information.

External Promoter with Access to the Data

Virtuleap, as an external collaborator, will have access to the participants' responses to the exercises. This data will be pseudonymized, ensuring that the participants' identities are not revealed. Virtuleap will use this information exclusively for monitoring and analyzing cognitive performance within the study.

Collaboration with Companies

We work in collaboration with the company Reality Telling for the development of VR content and with Virtuleap for the cognitive exercise platform.

- **Reality Telling**The results of the study will only be shared with them after being analyzed and without including personal data that would allow the participants to be identified.

- **Virtually**This platform collects data on user interaction with virtual reality exercises using random codes assigned to each session. These codes ensure that participants are not directly identified. This approach allows Virtuleap to provide detailed performance tracking and analysis without compromising individual privacy. The data collected is solely for the purpose of evaluating the effectiveness of the interventions and cannot be used to personally identify any participant, thus complying with applicable data protection regulations.

Data Storage Location, IT Tools and Security Measures

Physical Storage: The data collected using variable scales, initially recorded on paper, will be stored in a secure cabinet located at the El Carme Sociosanitary Center (CSSC). Access to this cabinet is strictly limited to authorized researchers, thus guaranteeing the confidentiality and integrity of the information.

Digital Storage: The results of the assessments, once pseudo-anonymized, will be transcribed into Excel spreadsheets. These files will be securely stored within the Badalona Serveis Assistencials (BSA) intranet, protected by advanced IT security systems to prevent unauthorized access.

IT Tools: The tools used to manage and analyze data have been carefully selected and approved by the BSA Information Systems Department. These tools meet the required IT security standards and are designed to ensure that data processing is efficient and secure. The technological infrastructure supports large-scale data management and ensures the integrity and confidentiality of information through rigorous access controls and encryption protocols.

International Data Transfers

No international data transfers are planned. All data will be maintained and processed within the European Economic Area (EEA).

High-Risk Treatments

No high-risk processing activities are anticipated, such as data profiling techniques, automated decision-making, artificial intelligence, data exploitation using Big Data technologies, biometric systems, or geolocation. All data will be used exclusively for the purposes of this study and will be handled in accordance with applicable data protection regulations.

8. PLANS FOR DISSEMINATING AND COMMUNICATING THE RESULTS

Our goal is to share the findings of this study on the use of virtual reality in cognitive decline with the scientific and medical community. Accordingly, we intend to publish the results of this study in a peer-reviewed scientific journal and, where possible, present them at a relevant conference or congress in the field. While we cannot guarantee acceptance in such platforms, we are committed to transparency and ethical practices, and we will strive to make our findings widely accessible.

9. SOURCE OF FUNDING

This study has no external funding. All costs associated with conducting the study, including intervention development, acquisition of virtual reality equipment and technology, data analysis, and patient management, will be fully covered by Badalona Serveis Assistencials (BSA).

BSA is committed to researching and developing new technologies and methods to improve cognitive rehabilitation in patients with mild cognitive impairment. This study is an integral part of its ongoing efforts to innovate and provide the best possible care for its patients.

10. WORK PLAN FOR CONDUCTING THE STUDY

Preparation of the protocol and submission to the Research Ethics Committee (REC)	May - June 2024
Assessment and Approval by the CEI	June - September 2024
Participant Recruitment and Pre-Intervention Data Collection	September 2024
Intervention	Sept 2024 - December 2025
Post-Intervention Data Collection	Sept24 - Dic 2025
Data Evaluation and Analysis	January - February 26
Final report	March 2026

The adjustments to the timeline are due to organizational reasons, with the aim of extending the patient recruitment and participation period. This change will allow for a more significant sample size, thus improving the ability to assess the results more reliably and extrapolate them, providing a more solid basis for interpreting the findings and their potential clinical application.

11. Attachments:

11.1. Annex 1: Participant Information Sheet

11.2. Annex 2.1: Informed Consent Participants

11.3. Annex 2.2: Informed Consent Responsible Parties
11.4. Appendix 3: Attention and Memory Test: TMT
11.5. Annex 4: SDMT
11.6. Anexo 5: Montreal Cognitive Assessment (MoCA)
11.7. Anexo 6: Mini-Mental State Examination (MMSE)
11.8. Annex 7: Lawton-Brody
11.9. Appendix 8. System Usability Scale (SUS) for patients
11.10. Annex 9. System Usability Scale (SUS) for professionals

ANNEX 1. Participant Information Sheet

Project Title: Non-Randomized Clinical Trial on Cognitive Stimulation with Virtual Reality in Patients with Mild Cognitive Impairment

Acronym -**RVEC-DCL**

PROMOTER	**Badalona Assistance Services (BSA)**
Protocol Code - REF.CEI	**PI-24-210**

PRINCIPAL INVESTIGATOR	José Ferrer Costa
CONTACT PHONE NUMBER	+34 937407482

CENTER	Badalona Care Services				
SERVICE	Innovation and Projects				
CENTER ADDRESS	Via Augusta, 9-13				
POPULATION	Badalona	**CP**	08911	**PROVINCE**	Barcelona

We are writing to inform you about a research study being conducted at Badalona Serveis Assistencials (BSA) in which we invite you to participate.
This project focuses on evaluating the potential of virtual reality (VR) experiences as a cognitive stimulation tool for people with mild or moderate cognitive impairment.
This study has been approved by the Clinical Research Ethics Committee (CEIC) of the Germans Trias i Pujol University Hospital. Our aim is to provide you with accurate and sufficient information to decide whether or not to participate in this study. Therefore, please read this document carefully, and we will answer any questions you may have.

Voluntary participation
You should know that your participation in this study is voluntary and that you can choose not to participate. If you decide to participate, you can change your decision and withdraw your consent at any time, without affecting your relationship with your doctor or impacting your medical care in any way.

Study Objective
Main Objective:

We want to know if the cognitive stimulation program with Virtual Reality is well accepted by patients with mild or moderate cognitive impairment.
Specific Objectives:
Is it useful and motivating?
We are interested in knowing if you find the VR activities useful and if they motivate you to continue participating in the program.
Does it improve your cognition?
We're going to measure how certain mental skills, such as attention and memory, change before and after using the VR program.

Professional Opinion:
We want to understand what healthcare professionals think about the use of VR in their daily work with patients like you.

How can we improve?
Your feedback and that of the medical staff will help us improve the program for future patients.

Basis for Improving Healthcare:
The data we collect could help develop better cognitive rehabilitation programs in the future.

Study Description
Several studies have shown that VR can be effective in improving cognitive abilities. This study seeks to investigate how personalizing VR experiences can increase the effectiveness of these interventions.

This intervention program will consist of 12 cognitive rehabilitation sessions using Virtual Reality, which will be held twice a week in conjunction with your regular appointments at the CSSC Day Hospital. Each session will last 45 minutes, with 15-20 minutes dedicated to specific exercises using virtual reality. The intervention will utilize Meta Quest 2 or 3 headsets, which incorporate hand-tracking technology to provide an immersive and accessible experience.

Study activities. What does your participation entail?:
The studio activities are divided into interactive exercises and immersive videos using virtual reality glasses.
Below we describe the exercises that will be carried out:

Description of Virtual Reality Activities:
The VR activities you will participate in are designed to stimulate different cognitive areas such as memory and executive functions. During these exercises, you will

always be accompanied by a therapist to ensure your safety and guide you through the activities. Some examples of exercises:

- Shopping at the Supermarket: You will select ingredients to make a recipe in a virtual supermarket. An animated avatar will guide you.
- Pay for your purchase: You will need to pay the exact amount for the selected products at the virtual checkout.
- Order the Recipe Steps: You will need to order photos of the recipe steps in a virtual kitchen.

Cognitive Stimulation with Immersive Videos:
360-degree videos have been recorded in familiar locations around Badalona to maximize the experience and comfort of the participants. The videos are of two types: static, where the perspective remains constant; and dynamic, which simulates a slow walk.
A therapist will guide the viewing, asking questions about the elements you see in the video to promote attention and memory.

Integration of the Virtuleap Platform:

What is Virtuleap?Virtuleap is a virtual reality platform designed to offer cognitive exercises that help improve various mental skills. In our study, this technology will be used in some specific sessions to provide advanced and engaging cognitive training.

Using Virtuleap in the Study: Virtuleap will only be incorporated into certain scheduled sessions, where it will be used to manage interactive activities and evaluate participants' responses and performance in a controlled and secure environment.

Security and Data Connection: We will establish a secure connection with the Virtuleap server, and it is important to note that no personal data that could directly identify you will be collected. During the exercises, the platform will only record your responses and interactions, without linking this information to your identity. This ensures that your participation in the activities is completely anonymous, protecting your privacy and ensuring the security of your personal information.

Performance Monitoring: To track your progress and performance in the activities, each session will be assigned a unique and impersonal code. This code does not reveal your identity and allows for an accurate assessment of your progress in the tasks without compromising your privacy.

This approach ensures that your study experience is safe and confidential, allowing you to participate in the intervention without worrying about the privacy of your personal data.

Participation in this study will not result in any changes to your treatment or the rest of your medical treatment.

Their participation also involves registering the study in their medical history and collecting data such as age, sex and type of cognitive impairment, in addition to completing scales and questionnaires with one of the professionals in the study.

Risks and Preventive Measures
Although the risks associated with VR use are generally low, some patients may experience dizziness or temporary disorientation, which usually resolves within a few minutes of rest, and less frequently, the risk of falls. In general use, 10 to 20% of people have been reported to experience some degree of dizziness when using VR, but during our previous study in our department, only 5% of participants were unable to complete sessions due to such discomfort. This is because measures have been implemented to minimize these risks, including the design of VR experiences with smooth movements and the gradual introduction of the technology.

To mitigate these risks, we have implemented several strategies:

- **Designing Experiences with Smooth Movements:**VR activities are designed to minimize sudden movement, reducing the likelihood of dizziness or disorientation.
- **Continuous Monitoring:**All participants are closely supervised by healthcare staff during VR sessions. This constant supervision ensures immediate intervention in case of discomfort and prevents the risk of falls.
- **Gradual Introduction to VR:**Participants gradually become familiar with VR technology, starting with shorter, simpler sessions that lengthen as they adapt to the virtual environment.

Potential Benefits
It is essential that you understand that your participation in this study does not guarantee direct health benefits. Our primary purpose is to investigate and gain a greater understanding of the potential of virtual reality experiences for cognitive stimulation in individuals with mild to moderate cognitive impairment.

However, participating in this study has some additional advantages that could be considered indirect benefits:

- Learning New Technologies: You will have the opportunity to familiarize yourself with the innovative technology of Virtual Reality, a tool that is being used more and more in the field of healthcare.

- Cognitive Stimulation: Although we cannot guarantee specific results, it is expected that the use of VR can enhance the effects of cognitive rehabilitation, improving areas such as memory and attention.
- Rewarding Experience: The VR sessions are gamified, meaning they have a game format, which could result in a personally rewarding experience and a time of distraction and entertainment.

Finally, it is important to note that although we are evaluating new interventions, we cannot anticipate their specific medical benefits. However, the data we collect will be invaluable in improving care for future patients with similar conditions.

Expenses and Financial Compensation
Your participation in this study will not involve any additional costs for you. You will not receive any financial compensation for participating in the study.

Who is funding the study?
This study does not have external funding; the expenses are covered by the BSA research department, and we have the collaboration of technology partners who will give us the right to use their software.

Confidentiality and Data Protection
In accordance with Articles 6.1.a and 9.2.a of Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (GDPR), we require your consent to use your health data for the purposes of this research project. The data will be retained in accordance with applicable law and for as long as necessary for the development of this project.

Your data will be processed in compliance with the GDPR and Organic Law 3/2018, on Data Protection and Guarantee of Digital Rights (LOPD-GDD). Therefore, you have the right to exercise your rights of access, rectification, erasure, objection, restriction of processing, and data portability with the Catalan Institute of Health (Institut Català de la Salut), with tax identification number (NIF) Q-5855029-Y and registered address at Gran Via de les Corts Catalanes 587, Barcelona, through the project's principal investigator. You can contact the BSA Data Protection Officer at dpd@bsa.cat.

We inform you that you have the right to withdraw your consent for the processing of this data at any time by notifying the principal investigator. You also have the right to file a complaint with the Catalan Data Protection Authority if you believe your rights have been violated.

No data communications to third parties are foreseen, beyond those legally established, nor are international data transfers foreseen.

We will collect data before and after the sessions to evaluate the effectiveness of the VR experiences. This data will include measures of your cognitive performance, as well as your impressions and experiences with VR. All data collected will be treated with the utmost confidentiality and will only be used for scientific purposes, to validate our hypotheses and improve this potential therapeutic tool.

Informed Consent
Before participating, you will need to sign an Informed Consent document that explains the study in detail.

Contact us if you have any questions.
If you have any questions or need more information, please feel free to contact our research team.
Research Team: jfcosta@bsa.cat, +34 937407482
BSA Data Protection Officer: dpd@bsa.cat, Tel. 93 253 18 20

We appreciate your consideration and hope to have your participation in this important study.

Sincerely,
The BSA research team.

Additional documentation:A copy of this document and the signed Informed Consent will be provided for your reference.

APPENDIX 2.1. Informed consent form for the patient

Informed Consent (IC) Form for Participant

Project Title: Non-Randomized Clinical Trial on Cognitive Stimulation with Virtual Reality in Patients with Mild Cognitive Impairment. Acronym -**RVEC-DCL**

PROMOTER	**Badalona Assistance Services (BSA)**
Protocol Code	

PRINCIPAL INVESTIGATOR	José Ferrer Costa
CONTACT PHONE NUMBER	+34 937407482

CENTER	Badalona Care Services				
SERVICE	Innovation and Projects				
CENTER ADDRESS	Via Augusta, 9-13				
POPULATION	Badalona	**CP**	08911	**PROVINCE**	Barcelona

them,(Name and surname)

I have read the information sheet that was given to me.

I was able to ask about the study.

I have received enough information about the study.

I have spoken with:___,_____.

I understand that my participation is voluntary.

I understand that I can withdraw from the study:

1st whenever I want

2nd without having to give explanations

3rd without this affecting my medical care.

I freely consent to participate in the study.

Patient's signature	Investigator's signature
Date:	Date:

APPENDIX 2.2. Informed consent form for the family member or legal representative

Informed Consent (IC) Form for the family member or legal representative

Project Title: Non-Randomized Clinical Trial on Cognitive Stimulation with Virtual Reality in Patients with Mild Cognitive Impairment. Acronym -**RVEC-DCL**

PROMOTER	**Badalona Assistance Services (BSA)**
Protocol Code	

PRINCIPAL INVESTIGATOR	José Ferrer Costa
CONTACT PHONE NUMBER	+34 937407482

CENTER	Badalona Care Services				
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CENTER ADDRESS	Via Augusta, 9-13				
POPULATION	Badalona	**CP**	08911	**PROVINCE**	Barcelona

them,(Name and surname of the representative)

I declare under my responsibility that:

(Patient's name and surname)

I have read the information sheet that was given to me.

I was able to ask about the study.

I have received enough information about the study.

I have spoken with:__,_____.

I understand that your participation is voluntary.

I understand that you can withdraw from the study:

1st whenever I want

2nd without having to give explanations

3rd without this affecting their medical care.

I freely give my consent for him to participate in the study.

Representative's signature	Investigator's signature
Date:	Date:

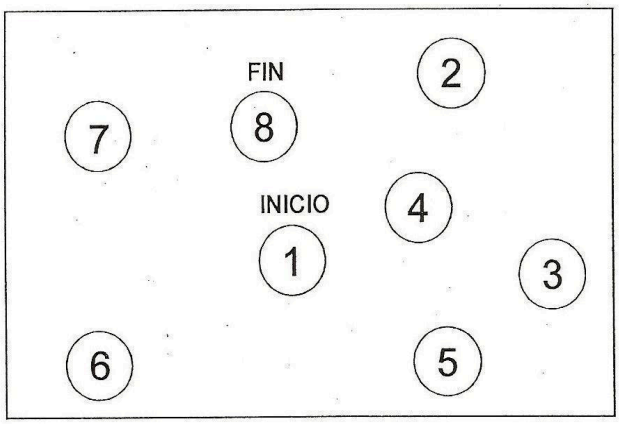
APPENDIX 3. Attention and Memory Test: TMT

Nombre_____Fecha nac._____Edad_____

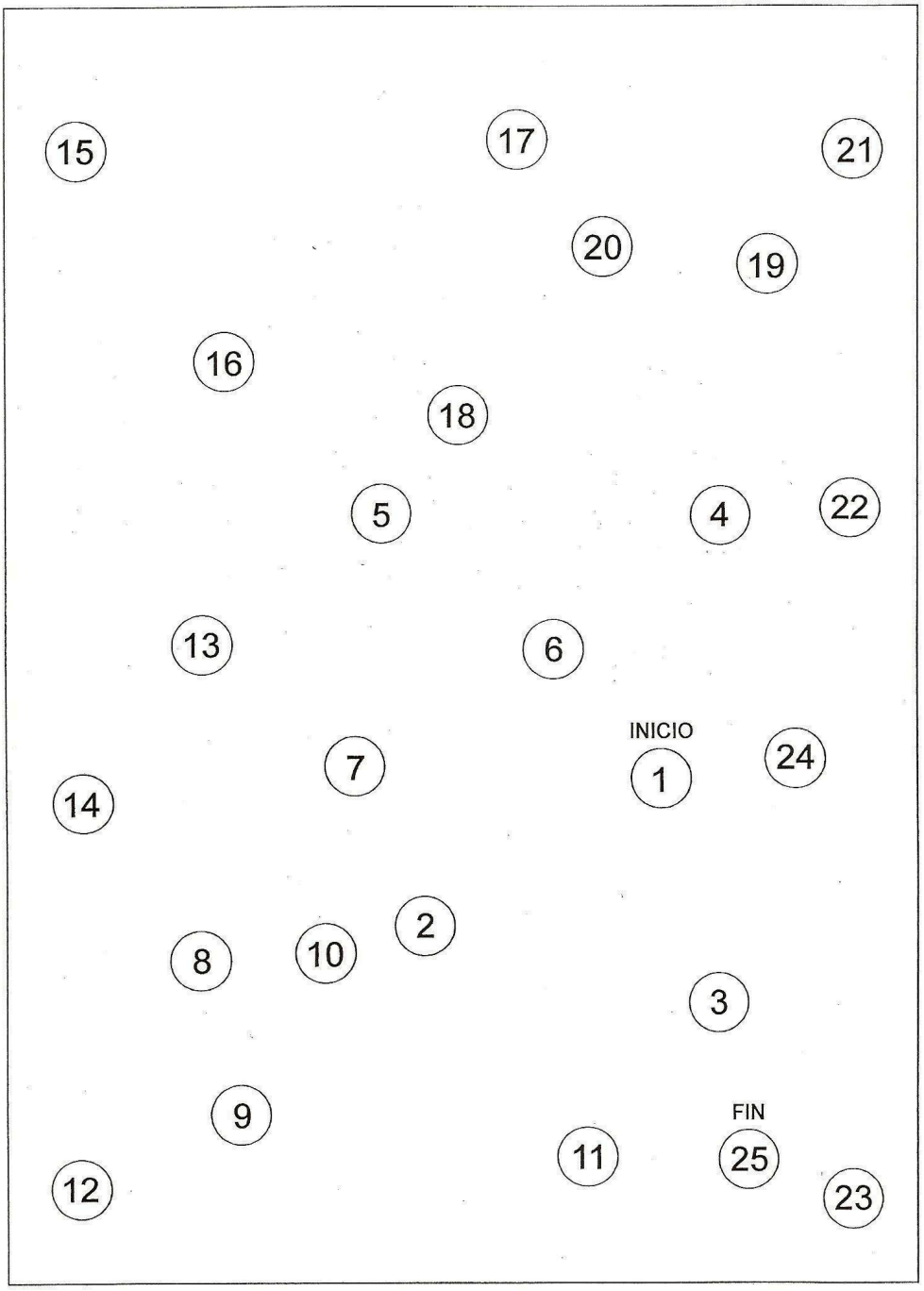
Escolaridad_____Fecha expl._____

TRAIL MAKING TEST (A)

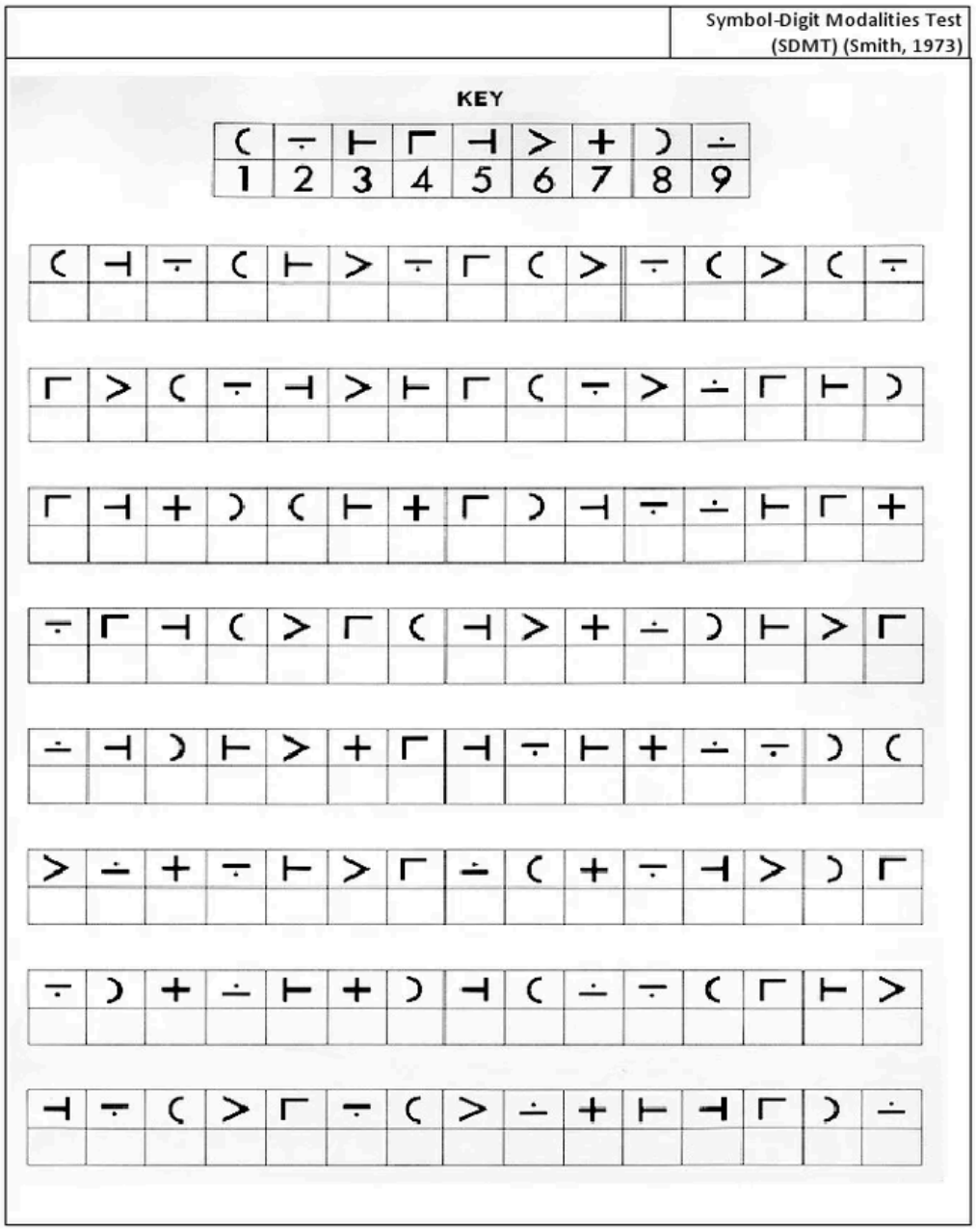
PRÁCTICA



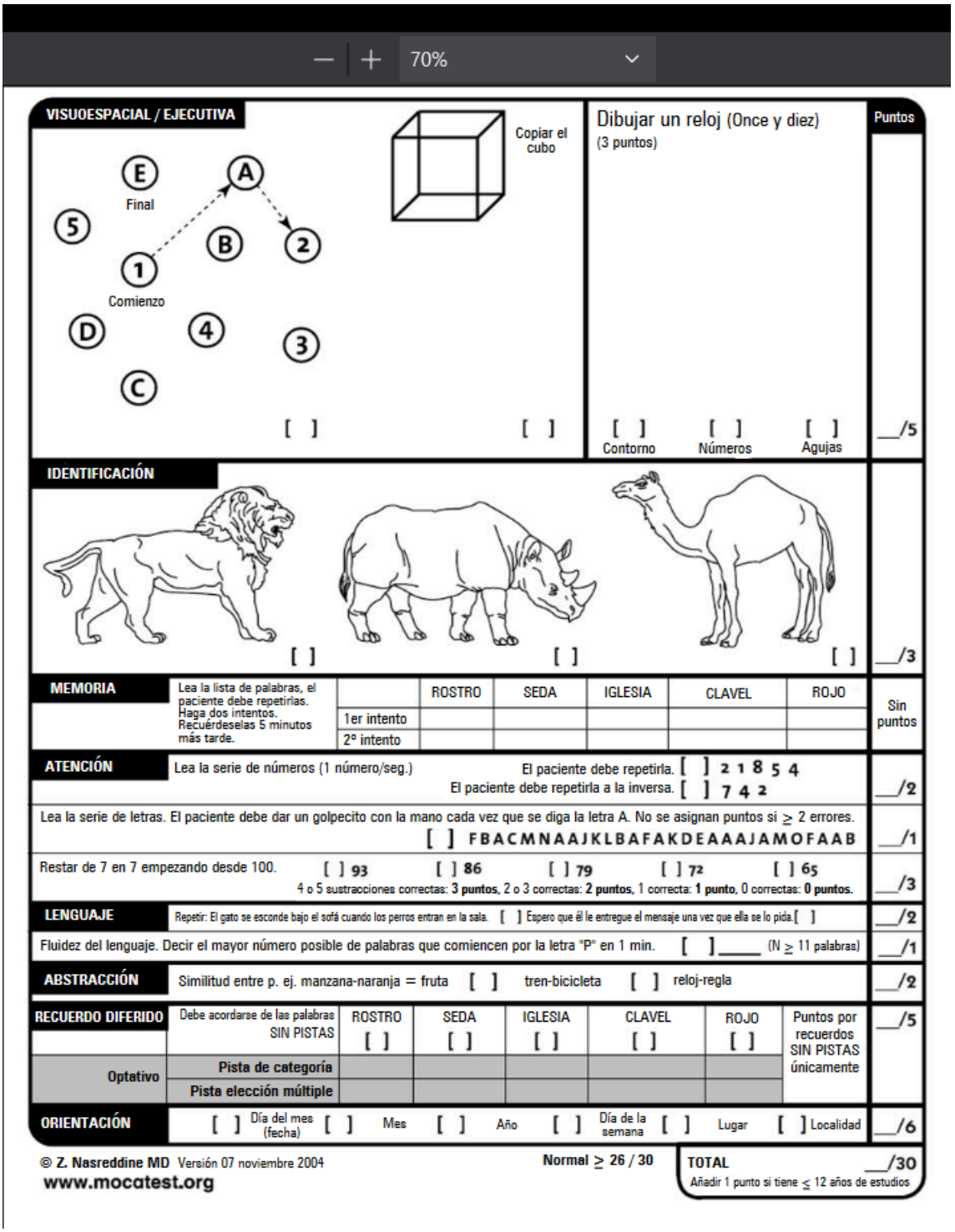
TIEMPO_____ Nº ERRORES_____


15
17
21
20
19
16
18
5
4
22
13
6
INICIO
7
24
1
14
2
8
10
3
9
FIN
11
25
12
23

ANNEX 4. SDMT


Symbol-Digit Modalities Test
(SDMT) (Smith, 1973)
KEY
1 2 3 4 5 6 7 8 9

ANEXO 5. Montreal Cognitive Assessment (MoCA)



VISUOESPACIAL / EJECUTIVA

Copiar el cubo

Dibujar un reloj (Once y diez) (3 puntos)

Puntos

E Final, A, 5, B, 2, 1 Comienzo, D, 4, 3, C

[ ] [ ]

[ ] Contorno [ ] Números [ ] Agujas

__/5

IDENTIFICACIÓN

[ ] [ ] [ ]

__/3

MEMORIA

Lea la lista de palabras, el paciente debe repetirlas. Haga dos intentos. Recuérdeselas 5 minutos más tarde.

	ROSTRO	SEDA	IGLESIA	CLAVEL	ROJO
1er intento					
2º intento					

Sin puntos

ATENCIÓN

Lea la serie de números (1 número/seg.) El paciente debe repetirla. [ ] 2 1 8 5 4

El paciente debe repetirla a la inversa. [ ] 7 4 2

__/2

Lea la serie de letras. El paciente debe dar un golpecito con la mano cada vez que se diga la letra A. No se asignan puntos si ≥ 2 errores.

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

__/1

Restar de 7 en 7 empezando desde 100. [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 o 5 sustracciones correctas: **3 puntos**, 2 o 3 correctas: **2 puntos**, 1 correcta: **1 punto**, 0 correctas: **0 puntos**.

__/3

LENGUAJE

Repetir: El gato se esconde bajo el sofá cuando los perros entran en la sala. [ ] Espero que él le entregue el mensaje una vez que ella se lo pida. [ ]

__/2

Fluidez del lenguaje. Decir el mayor número posible de palabras que comiencen por la letra "P" en 1 min. [ ]_____ (N ≥ 11 palabras)

__/1

ABSTRACCIÓN

Similitud entre p. ej. manzana-naranja = fruta [ ] tren-bicicleta [ ] reloj-regla

__/2

RECUERDO DIFERIDO

	Debe acordarse de las palabras SIN PISTAS	ROSTRO	SEDA	IGLESIA	CLAVEL	ROJO	Puntos por recuerdos SIN PISTAS únicamente
		[ ]	[ ]	[ ]	[ ]	[ ]	
Optativo	Pista de categoría						
	Pista elección múltiple						

__/5

ORIENTACIÓN

[ ] Día del mes (fecha) [ ] Mes [ ] Año [ ] Día de la semana [ ] Lugar [ ] Localidad

__/6

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www.mocatest.org

Normal ≥ 26 / 30

TOTAL __/30

Añadir 1 punto si tiene ≤ 12 años de estudios

ANEXO 6. Mini-Mental State Examination (MMSE)

MINI MENTAL STATE EXAMINATION (MMSE)

Nombre: Hombre [ ] Mujer [ ]

Fecha: Fecha de nacimiento: Edad:

Estudios/Profesión: Observaciones:

¿En qué año estamos? **0-1** ¿En qué estación? **0-1** ¿En qué día (fecha)? **0-1** ¿En qué mes? **0-1** ¿En qué día de la semana? **0-1**	**ORIENTACIÓN TEMPORAL** (máx. 5)	
¿En qué lugar estamos? **0-1** ¿En qué piso o sala? **0-1** ¿En qué ciudad? **0-1** ¿En qué estado estamos? **0-1** ¿En qué país? **0-1**	**ORIENTACIÓN ESPACIAL** (máx. 5)	
Nombre tres palabras moneda-caballo-manzana a razón de 1 por segundo. Luego se pide al paciente que las repita. Esta primera repetición otorga la puntuación. Otorgue 1 punto por cada palabra correcta, pero continúe diciéndolas hasta que el sujeto repita las 3, hasta un máximo de 6 veces. Moneda **0-1** Caballo **0-1** Manzana **0-1**	Núm. de repeticiones necesarias **FIJACIÓN RECUERDO** inmediato (máx. 3)	
Si tiene 30 pesos y me va dando de tres en tres, ¿Cuántos le van quedando? Detenga la prueba tras 5 sustracciones. Si el sujeto no puede realizar esta prueba, pídale que deletree la palabra MUNDO al revés. 30 **0-1** 27 **0-1** 24 **0-1** 21 **0-1** 18 **0-1** (O **0-1** D **0-1** N **0-1** U **0-1** M **0-1**)	**ATENCIÓN CÁLCULO** (máx. 5)	
Preguntar por las tres palabras mencionadas anteriormente. Moneda **0-1** Caballo **0-1** Manzana **0-1**	**RECUERDO DIFERIDO** (máx. 3)	
DENOMINACIÓN. Mostrarle un lápiz o un bolígrafo y preguntar ¿qué es esto? Hacer lo mismo con un reloj de pulsera, lápiz **0-1**, reloj **0-1**. **REPETICIÓN.** Pedirle que repita la frase: "ni sí, ni no, ni pero" **0-1**. **ÓRDENES.** Pedirle que siga la orden: "tome un papel con la mano derecha, dóblelo por la mitad, y póngalo en el suelo". Tome con la mano derecha **0-1** dobla por la mitad **0-1** pone en suelo **0-1**. **LECTURA.** Escriba legiblemente en un papel "cierre los ojos". Pídale que lo lea y haga lo que dice la frase **0-1**. **ESCRITURA.** Que escriba una frase (con sujeto y predicado) **0-1**. **COPIA.** Dibuje 2 pentágonos **entrecruzados**  y pida al sujeto que los copie tal cual. Para otorgar un punto deben estar presentes los 10 ángulos y la intersección **0-1**.	**LENGUAJE** (máx. 9)	
Puntuaciones de referencia: 27 ó más: normal 24 ó menos: sospecha patológica 12-24: deterioro cognitivo 9-12: demencia	**PUNTUACIÓN TOTAL** (máx. 30 puntos)	

ANNEX 7. Lawton-Brody

		Puntos
A.	**CAPACIDAD PARA USAR EL TELÉFONO**	
1.	Utiliza el teléfono a iniciativa propia, busca y márca los números, etc	
2.	Marca unos cuantos números bien conocidos	1
3.	Contesta el teléfono pero no marca	1
4.	No usa el teléfono	0
B.	**IR DE COMPRAS**	
1.	Realiza todas las compras necesarias con independencia	1
2.	Compra con independencia pequeñas cosas	0
3.	Necesita compañía para realizar cualquier compra	0
4.	Completamente incapaz de ir de compras	0
C.	**PREPARACIÓN DE LA COMIDA**	
1.	Planea, prepara y sirve las comidas adecuadas con independencia	1
2.	Prepara las comidas si se le dan los ingredientes	0
3.	Calienta y sirve las comidas pero no mantiene una dieta adecuada	0
4.	Necesita que se le prepare y sirva la comida	0
D.	**CUIDAR LA CASA**	
1.	Cuida la casa sólo o con ayuda ocasional (ej. Trabajos pesados)	1
2.	Realiza tareas domésticas ligeras como fregar o hacer cama	1
3.	Realiza tareas domésticas ligeras pero no puede mantener un nivel de limpieza aceptable	1
4.	Necesita ayuda en todas las tareas de la casa	1
5.	No participa en ninguna tarea doméstica	0
E.	**LAVADO DE ROPA**	
1.	Realiza completamente el lavado de ropa personal	1
2.	Lava ropa pequeña	1
3.	Necesita que otro se ocupe del lavado	0
F.	**MEDIO DE TRANSPORTE**	
1.	Viaja con independencia en transportes públicos o conduce su coche	1
2.	Capaz de organizar su propio transporte en taxi, pero no usa transporte público	1
3.	Viaja en transportes públicos si le acompaña otra persona	1
4.	Sólo viaja en taxi o automóvil con ayuda de otros	0
5.	No viaja	0
G.	**RESPONSABILIDAD SOBRE LA MEDICACIÓN**	
1.	Es responsable en el uso de la medicación, dosis y horas correctas	1
2.	Toma responsablemente la medicación si se le prepara con anticipación en dosis preparadas	0
3.	No es capaz de responsabilizarse de su propia medicación	0
H.	**CAPACIDAD DE UTILIZAR EL DINERO**	
1.	Maneja los asuntos financieros con independencia, recoge y conoce sus ingresos	1
2.	Maneja los gastos cotidianos pero necesita ayuda para ir al banco, grandes gastos, etc	1
3.	Incapaz de manejar el dinero	0

Máxima dependencia: 0 puntos
Independencia total: 8 puntos

APPENDIX 8. System Usability Scale (SUS) for patients

System Usability Scale (SUS) for patients					
Simulation evaluation - System usability scale	**Strongly disagree**	**Slightly disagree**	**Neutral**	**I somewhat agree**	**I mostly agree**
1 I think I would like to use this program frequently					
2 I think there are too many stimuli					
3 I think the exercises with the glasses are more entertaining than the conventional way.					
4 I think the simulation options are clear and well integrated					
5 I think some options are difficult to follow					
6 I believe people will be able to learn to use this system easily					
7 I felt comfortable using this system					
8 I had to learn many things before I could use the system					
VR headset review - Meta Quest 2 or 3	**Strongly disagree**	**Slightly disagree**	**Neutral**	**I somewhat agree**	**I mostly agree**
1 The glasses were very heavy and uncomfortable					
2 The use of the glasses and controllers has been very complicated					
3 I have felt tiredness in my arms and fingers					
4 I have experienced visual discomfort					
5 I felt dizzy					
6 I have felt a headache					
7 I had to stop the simulation due to the aforementioned discomfort.					
8 I think it would be comfortable to wear these glasses for a long time					

COMMENTS:

APPENDIX 9. System Usability Scale (SUS) for professionals

System Usability Scale (SUS) for professionals					
Simulation evaluation - System usability scale	**Strongly disagree**	**Slightly disagree**	**Neutral**	**I somewh at agree**	**I mostly agree**
1 I believe this program will help improve the quality of patient care.					
2 I think the program interface is intuitive for the user.					
3 I believe the program can be easily integrated into daily clinical practice.					
4 I believe that the functions and characteristics of simulation are clear and relevant to patient care.					
5 Some of the functionalities of this system may be difficult for patients to understand or use.					
6 I believe that patients will be able to learn to use this system easily.					
7 I have felt comfortable using this system for patient care.					
8 I needed additional time to learn how to use this system correctly.					
VR Headset Review - Quest 2	**Strongly disagree**	**Slightly disagree**	**Neutral**	**I somewh at agree**	**I mostly agree**
1 I think the weight and design of the glasses could be uncomfortable for patients.					
2 I think that using the glasses and controls could be complicated for some patients.					
3 I believe that patients would be able to use these glasses for an extended period of time without discomfort.					

COMMENTS: